The Bow River

Report of the

Bow River
WATER QUALITY
TASK FORCE

November 1991

Cover painting *Headwaters of the Bow* by Cynthia Mackenzie.

Cynthia Mackenzie was born in Vancouver and graduated from the Alberta College of Art Fine Arts program in 1975.
Her delicate and detailed watercolors are represented in collections in Canada, the United States and Europe.

92-01603/

The Honourable Ralph Klein
Minister of the Environment
Room 130, Legislature Building
Edmonton, Alberta T5K 2B6

Bow River
WATER QUALITY
TASK FORCE

November 26, 1991

Dear Mr. Klein:

We are pleased to enclose the final report of the Bow River Water Quality Task Force. The report consists of two volumes. The first contains the body of our report and recommendations as well as several appendices. The second consists of an appendix of technical information relating to the report.

The Task Force was comprised of 21 members representing a broad spectrum of individual stakeholder groups throughout the Bow River Basin. The Task Force members were volunteers who spent a great deal of their own time reviewing materials and attending meetings of the Task Force and its various subcommittees. For those members who had to travel some distance to attend these meetings the time commitment was even greater. Members of the Task Force were not selected for their expertise in water quality issues but rather were a representative cross-section of the nearly one million people who live in the Basin and who consider the river their lifeline. Throughout the course of our task we received and studied data and reports, and as well listened to and questioned a great number of experts, technicians and consultants relating to a broad range of water quality issues. The time and effort committed to this task by all members is evidence of the deep concern they have for the preservation and protection of the Bow River.

The members of the Task Force would like to express their sincere appreciation to Kerry Lowe and Dick Hart from Alberta Environment for their efforts and patience in acting as facilitators to the Task Force and in providing much needed input from various government departments and other agencies.

It is safe to say that at the commencement of our proceedings the magnitude of the task was not fully appreciated by all of us. The wide variety of issues, complexity of problems and diversity of interests required considerable time and effort to understand and reconcile. The one common thread throughout all of the proceedings, however, was the desire of all members of the Task Force to improve and preserve the river, which the members consider to be a fragile resource of great importance to Albertans. One of the perhaps unstated, but certainly important, results coming out of this Task Force was an understanding by the various stakeholder members that the problems related to water quality in the Bow River are not singular and that there is no one simple solution. We have come to recognize that we are all part of the problem and in order to achieve our goals we must all be part of the solution.

It is easy for us to become complacent and take for granted the beauty and value of the Bow River. All too often we have heard comments that the water quality of the Bow River is not a problem when compared to some other rivers in Canada and throughout the world. The members of the Task Force do not accept

this position. Real and serious problems now exist; but at the same time we have the opportunity to take corrective steps to remedy the situation and to implement long-term measures to preserve and protect this unique and valuable resource.

The members of the Task Force commend the Minister for his initiatives in dealing with these issues. It is hoped that the recommendations in this report will be looked upon favourably and that the Provincial Government will take a lead role in implementing them.

Yours very truly,

John W. Donahue, Q.C.,
Chairman, Bow River Water Quality Task Force

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Acknowledgements

During the course of this assignment, the Bow River Water Quality Task Force (Task Force) received presentations from numerous individuals who have a role or a stake in water quality management in the Bow River Basin. A list of these contributors and the subject area of their presentations is provided in Appendix IV. The Task Force is grateful for the contribution of these individuals.

Technical guidance for the work of the Task Force was provided by Environmental Management Associates (EMA). The Task Force would like to express its appreciation to all the staff of EMA who contributed information and valuable advice in bringing the assignment to its conclusion. In particular, the Task Force acknowledges the work of Hal Hamilton who put in long hours in meeting tight deadlines.

The Task Force thanks the following contributors for the use of their photos: Lynda and Jim McLennan, Jim Rouse, Al Taylor, Bryan Kemper, Anton Zybach, Elaine Peake, Wolf Keller, Colin Beresford, and the Eastern Irrigation District.

Meetings of the Task Force were held at the McDougall Centre, the Energy Resources Conservation Building, the Bonnybrook Sewage Treatment Plant, the Banff Centre, and the Southern Alberta Pioneer's Hall. The Task Force extends its thanks to the staff of those organizations for their accommodations and for being gracious hosts.

The work of Kerry Lowe of Alberta Environment in organizing the meetings of the Task Force and providing administrative and secretarial services is gratefully acknowledged. Finally, the Task Force would like to extend its thanks to Dick Hart of Alberta Environment for his efforts and patience throughout the assignment in arranging for input from various government departments and other agencies and in responding to the numerous requests by the Task Force for information.

Executive Summary

The 619 km long Bow River rises in the Rocky Mountains within Banff National Park and flows through foothills and prairies to its confluence with the Oldman River in southeastern Alberta.

The Bow River is the lifeline of southern Alberta and one of our most important resources. It serves as a source of water for domestic, municipal, industrial, hydropower, recreational and irrigation purposes. As the population within the Bow River Basin expands and demands on the river increase, limited water supply and poor water quality pose a threat to water users. If the river is to continue to serve a diversity of uses, more effective management of the quality, supply and use of the water will be required.

In response to increasing public concern about existing and potential future problems with Bow River water quality, the Honourable Ralph Klein, Minister of Environment, formed the Bow River Water Quality Task Force. The Task Force commenced work in May 1990 with a membership of stakeholders from throughout the Basin. The objectives of the Task Force were to:

1. Enquire into the specific causes of pollution in the Bow River.
2. Recommend specific measures to reduce or eliminate those causes of pollution, or if insufficient information exists to recommend specific measures, recommend a course of action to further address issues or concerns.
3. Recommend measures that would protect the Bow River against sources of pollution in the future.
4. Provide preliminary cost estimates and identify the benefits of implementing various recommendations.
5. Identify funding alternatives for implementation.

To meet these objectives, the Task Force received presentations from numerous individuals who have expertise in water quality management in the Bow River Basin. In addition, it scrutinized reports, data and information made available to it by government agencies and authorities. It also considered new data that it had collected.

This report presents the findings of the Task Force. It includes an overview of existing water quality conditions and management practices within the Basin, identifies sources of pollutants to the River, gives 33 recommendations to improve and protect river water quality, provides preliminary cost estimates, and identifies the benefits of implementing these recommendations.

Currently, the major problems with water quality of the Bow River occur within and downstream of Calgary where elevated levels of bacteriological indicators, organic contaminants, nutrients, ammonia and low nighttime oxygen levels are of concern. The sources of these pollutants include municipal and industrial effluents, urban runoff, contaminated groundwater seepage, and possibly agricultural runoff.

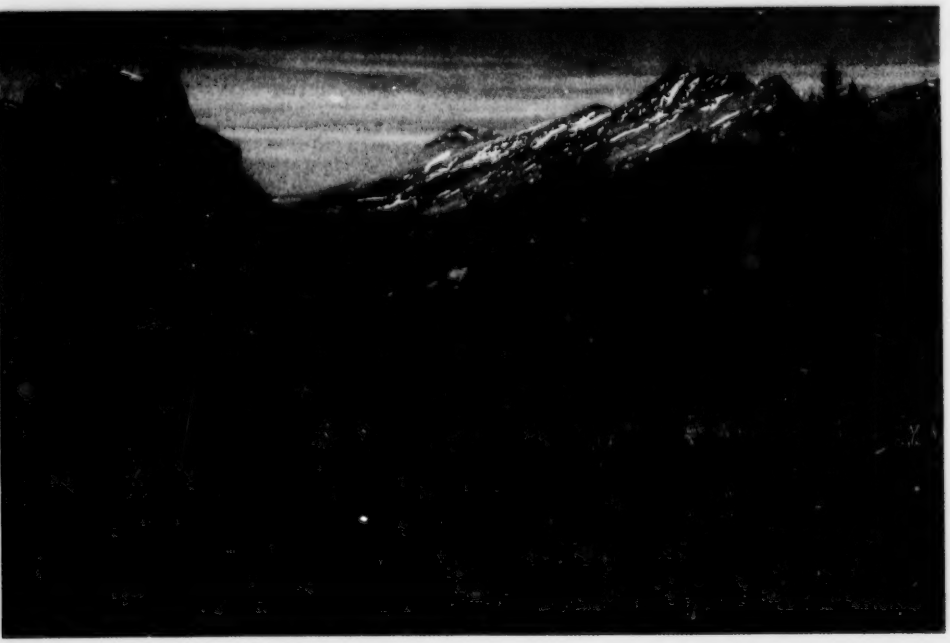
The Bow River Water Quality Task Force recognizes the needs of all water users in the Basin. It has developed the following overall vision for

water quality in the Bow River Basin to assist in the formulation of its recommendations:

The Bow River will be conserved and protected as a fragile and unique resource and recognized as our lifeline. This vision allows for a balance of multiple uses, ensuring that the needs of all stakeholders are considered, but recognizing that a healthy ecosystem is paramount.

The specific recommendations made by the Task Force to improve and protect river water quality are briefly summarized as follows:

- establish a permanent Bow River Water Quality Council to promote awareness, improvement and protection of Bow River water quality
- define the assimilative capacity of the river to assist in preparing effluent disposal strategies over the next 50 years
- continue to research and implement more advanced wastewater treatment technologies
- develop sewage treatment plants for smaller communities on a regional rather than isolated basis
- implement alternatives to river disposal of wastewaters such as wetland treatment
- require safe disinfection of all direct municipal sewage discharges in the Basin, including Canmore and Calgary's Fish Creek Sewage Treatment Plant
- implement water conservation measures, including universal metering of municipal water
- develop tighter regulations and enforcement measures for industries that discharge to municipal treatment systems to reduce industrial pollution and toxic contaminants reaching the River
- investigate alternative water release strategies for hydropower reservoirs
- optimize and expand current water quality monitoring programs
- report the status of Bow River water quality in an annual State-of-the-River report to be prepared and made public by the Bow River Water Quality Council
- expand the centralized water quality database currently maintained by Alberta Environment
- establish a monitoring program to determine the impact of urban and agricultural runoff on river water quality
- implement by-laws and regulations to eliminate the effects of new urban land development on urban runoff quality
- evaluate the effects of existing urban developments on Bow River water quality and, where feasible, retrofit existing urban drainage basins with stormwater treatment facilities
- establish new programs and encourage existing ones to increase public awareness of the effect of contaminants discharged to the Bow River from storm sewers
- establish enforceable procedures to minimize effects of new intensive livestock operations on water quality
- identify existing intensive livestock operations adversely affecting water quality in the River



Canoeing is a popular pursuit on the Bow River.

and implement remedial measures on a cost-shared basis

- assess impact of open-range livestock operations on water quality and implement remedial measures if necessary
- investigate the impact of agricultural chemicals on water quality and if necessary implement a program to control such impacts
- implement specific procedures to minimize golf course runoff
- clean-up or contain contaminants at the Canada Creosote site in Calgary in a manner that will eliminate any significant risk to human health and the aquatic ecosystem
- identify all other contaminated industrial sites in the Basin that may potentially affect river water quality and prioritize required remedial action
- establish an inter-governmental committee to coordinate water quality activities within the Basin
- provide input, via the Bow River Water Quality Council, to the new regulations for the Environmental Protection and Enhancement Act
- initiate a Bow River water management planning program
- ensure that diversions of water from the Highwood River do not adversely affect downstream water quality and quantity in the lower Highwood and Bow Rivers
- establish a program to increase public awareness of the need to disinfect all surface water used for drinking

- submit the Bow River as a candidate for inclusion in the Canadian Heritage River Program if the Province elects to become part of the Program
- clarify and improve spill containment and emergency response procedures in areas of the Bow Basin under federal control
- review and clarify the multiplicity of legislation and regulations for water quality protection in the Basin
- consolidate regulation of private sewage disposal to Alberta Environment and Alberta Health
- implement Basin-wide programs to reduce littering in the Bow River Valley

Further detail and the rationale for these recommendations plus implementation costs and associated benefits are given in Section 5 of the report.

In total, it is estimated that implementation of these recommendations would require a one-time cost of $4,150,000 spread over several years plus additional annual operating costs of $375,000.

The Task Force has investigated a number of alternatives that could be considered, in whole or in part, to create funds to implement the recommendations of this report. These funding opportunities include optimizing existing resources, water user fees, water disposal fees, a water quality trust fund, a tax on certain fertilizers and pesticides, and increasing fines pertaining to violation of water pollution control and fishing regulations.

1.0 Task Force Mandate and Objectives

One of southern Alberta's most important resources is the Bow River. It serves as a source of water for domestic, municipal, industrial, hydropower and irrigation purposes. With the exception of hydropower, water demands for these uses are increasing. Recreational pursuits such as boating, fishing, swimming and a variety of land based activities are also very popular throughout the whole Bow River Basin. Anglers from around the world are attracted to it because of its international reputation for supporting a large and plentiful rainbow and brown trout fishery.

As the population within the Basin and demands on the Bow River increase, limited water supply and poor water quality pose a threat to water users. If the river is to continue to serve a diversity of uses, more intensive management of the quality, supply and use of the water will be required.

Government and other agencies have conducted numerous investigations relating to Bow River water quality and pollution control. However, in response to increasing public concern about existing and potential future problems with Bow River water quality, the Honourable Ralph Klein, Minister of Environment, formed the Bow River Water Quality Task Force.

The Task Force commenced work in May 1990 with a membership made up of representative stakeholders, municipalities and special interest groups from throughout the Basin (see Appendix I).

The objectives of the Task Force were to:

1. Enquire into the specific causes of pollution in the Bow River.
2. Recommend specific measures to reduce or eliminate those causes of pollution, or if insufficient information exists to recommend specific measures, recommend a course of action to further address issues or concerns.
3. Recommend measures that would protect the Bow River against sources of pollution in the future.
4. Provide preliminary cost estimates and identify the benefits of implementing various recommendations.
5. Identify funding alternatives for implementation.

The full terms of reference of the Task Force are given in Appendix II.

The Task Force focused on water quality of the Bow River. However, sources of pollution in the entire Basin, that individually or collectively affect Bow River water quality, were also considered. Because water quality and quantity are interdependent, the Task Force also had the mandate to look at the effects of flow regulation and water diversions and withdrawals on water quality. In meeting its goals the Task Force primarily used data and information made available to it by government agencies and authorities. However, when forming their recommendations, member groups and consultants also considered a limited amount of new data they had collected.

This report presents the Task Force findings on the existing status of Bow River water quality, and recommends to the Minister of Environment what actions should be undertaken to improve and protect the Bow River's water quality in the future. In addition, the unique reaches of the river and their associated primary water uses are described and the Task Force formulated a vision for river water quality that should be considered in establishing future water management objectives.

The diverse topographical terrain and climatic areas through which the Bow River and its tributaries flow encourage a variety of water uses. Near the source, and while still within the mountains, much of the river is used for recreation. As its flow increases and the river passes through larger municipalities and the City of Calgary, water is needed for municipal and industrial supplies. In the drier eastern reaches of the Bow River large diversions of water for irrigation are required. Figure 1 shows the river basin and political boundaries.

The Task Force has divided the 619 kilometre Bow River into eight different reaches. Each reach is unique because it is influenced by its geographical location. Figure 2 indicates water use within the drainage basin of each reach.

REACHES

1. Headwaters to Upstream Lake Louise (35 km)

Flowing through the magnificent wilderness of the Rocky Mountains in Banff National Park, the headwaters of the Bow River are largely untouched and pristine. The area is renowned for its beauty and highly valued by white-water enthusiasts and tourists. The river here is not particularly productive for fish but provides important habitat for wildlife.

2. Lake Louise to Banff Park Boundary (80 km)

This reach, which flows through Banff National Park, receives water from the Spray River. The river supports a modest trout and whitefish fishery, and the emphasis of water use is on recreation and aesthetic enjoyment. Human influence is first noticed here because of direct effluent discharges and urban runoff from the communities of Banff and Lake Louise.

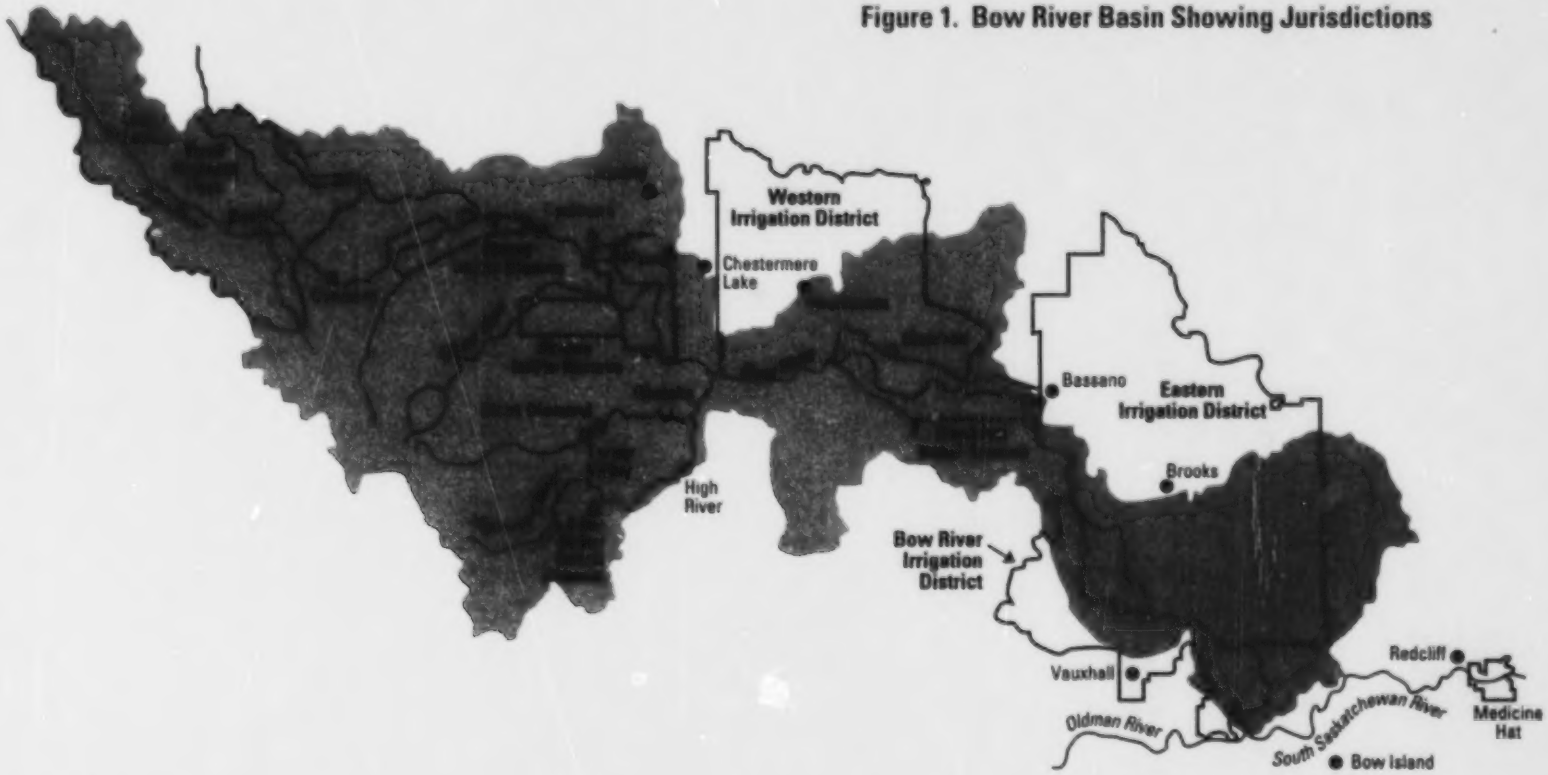
3. Banff Park to Bearspaw Dam (115 km)

In this reach the river leaves the mountains to wind its way through the foothills onto the prairie. It flows through the Stoney Indian Reserve and several municipalities and the demands on it increase substantially. Ghost River, Spray Lakes and Kananaskis River are the major sources of water along this reach. Storage reservoirs and hydropower production in this reach are common. Also, agricultural uses become more significant as the river flows through ranch country. Livestock must be watered and a small amount of the river water is diverted for irrigation. Some industrial discharge enters the river in the Cochrane, Canmore and Exshaw areas.

4. Below Bearspaw Dam to Western Irrigation District Weir (28 km)

This reach is entirely within the City of Calgary and major tributaries are Elbow River and Nose Creek. In this reach, the Bow River encounters all the new demands expected from a large urban centre. This reach is one of the most complex from a water use perspective. The Bow and Elbow Rivers provide drinking water for a large portion of the Basin's population. The first major diversion of the river to irrigation use is in the Western

Figure 1. Bow River Basin Showing Jurisdictions



Irrigation District (WID) with water being used for agricultural, recreational, municipal and domestic uses. Chestermere Lake is part of the WID system. The high level of recreational and aesthetic enjoyment by area residents is unique within the Basin. A good trout fishery provides many hours of pleasure to anglers. Kayakers, rafters and canoeists dot the waterways throughout the summer. In addition, there is substantial urban and industrial drainage, either directly into the Bow River or via Elbow River and Nose Creek drainages.

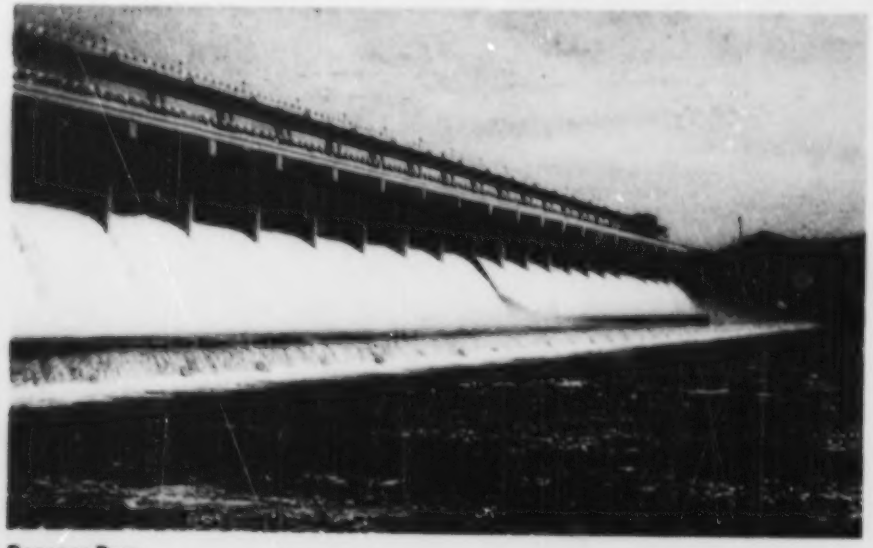
5. Below WID Weir to Highway 22X (25 km)

This reach, which is also within the City of Calgary and includes Fish Creek Provincial Park, receives treated effluent from both Calgary sewage treatment plants, as well as its industrial discharges. Irrigation is minor and is mainly for golf courses. However, a prime trout fishery exists in this part

of the Bow River. The Inglewood Bird Sanctuary on the shore of the river is an important urban wildlife reserve.

6. Highway 22X to Carseland Weir (53 km)

This reach, which flows through rural municipalities, includes the Sheep and Highwood Rivers and the headwaters of the Bow River Irrigation District (BRID). The water flow begins to slow down as the river meanders through this region. This reach supports one of the best large, wild trout fisheries in North America. Diversion is high because of irrigation, primarily within the BRID. A small amount of water is also diverted for industrial use in the Carseland area.



Bassano Dam.

7. Below Carseland Weir to Bassano Dam (136 km)

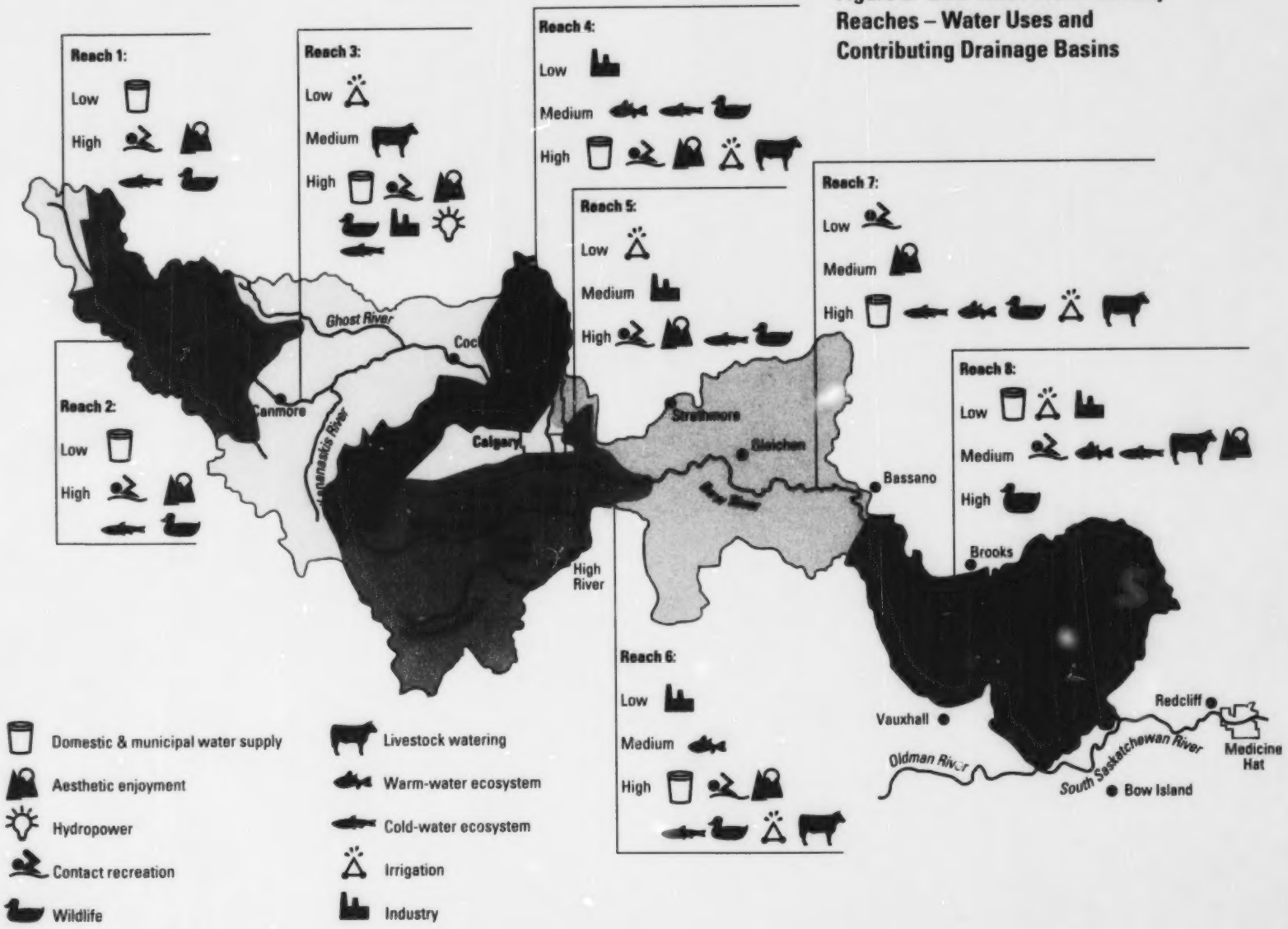
This prairie reach flows through the Eastern Irrigation District (EID), Siksika Nation Reserve and rural municipalities. The EID provides much needed water for agricultural use. Also the demands for municipal, recreational and wildlife water use are high. In this reach, the river also supports a mixture of warm and cold water species of fish.

8. Below Bassano Dam to Oldman River (147 km)

This river reach flows through rural municipalities across mostly undulating prairie. Water use in this prairie reach becomes more restricted. Anglers enjoy the warm water fishery and the river is important for wildlife as well as livestock watering. Water taken directly from the river for irrigation, industrial, and municipal and domestic use is minimal.

This reach terminates at the mouth of the Bow River where it joins the Oldman River to form the South Saskatchewan River. That river flows eastward through Medicine Hat into Saskatchewan, where it eventually drains via the Saskatchewan-Nelson River system into Hudson Bay.

Figure 2. Bow River Water Quality Reaches – Water Uses and Contributing Drainage Basins



3.0 The Future of the Bow River

As the Bow River flows from mountain terrain through rolling foothills and onto the vast undulating prairie, the demands on the river vary considerably. The greatest need is for a reliable supply of clean water for domestic and municipal use. This urban need increases significantly as the river travels eastward towards Calgary. The river is vital in supporting the economic needs of industry and agriculture, but high water quality is also of extreme importance to anglers and recreationists. Industrial, agricultural and hydropower needs must be met with no adverse effect to downstream users. The Task Force recognizes the needs of all the water users and after considerable thought has developed the following overall vision for water quality in the Bow River Basin.

3.1 OUR OVERALL VISION

The Bow River will be conserved and protected as a fragile and unique resource and recognized as our lifeline. Our vision allows for a balance of multiple uses, ensuring that the needs of all stakeholders are considered, but recognizing that a healthy ecosystem is paramount.

Elements of this vision are that:

a The Bow River will be a reliable source of drinking water for an expected one million people living in its Basin.

b The Bow River will be safe over its full length for contact recreational activities.

c We will recognize and take pride in the Bow River and its natural setting, its exceptional beauty, and its contribution to the quality of life.

d We will recognize the Bow River for its significance to the historical development of Canada.

e The Bow River will be carefully and efficiently managed on a basin-wide basis.

f All significant surface and ground water contaminants will be identified and brought under control.

g The Bow River will be widely recognized and respected as an example of river basin management.

h Despite increasing demands on the Bow River, we think it is reasonable in our vision to aim for no further deterioration of the river's quality and to expect general improvement in the years to come.

3.2 REALIZATION OF OUR VISION

Fulfilment of our vision requires certain assumptions and realities be recognized:

a A variety of economic and technical constraints must be faced as we move toward our vision of the Bow River.

b Each river reach will have specific objectives and goals.

c Only with cooperation among stakeholders and sharing of resources will improvements in Bow River water quality be possible.

d The use of resources and any actions taken need to be coordinated so that improvements can be made on a priority basis.

e Resources for these improvements must come from a broad range of sources including all levels of government and stakeholders.

f Urban growth will continue and we have limited ability to change river flows and increase waste assimilative capacity.

g Health authorities recommend that some level of drinking water treatment be required in all river reaches.

h The water quality of the Bow River is significantly influenced by its tributaries, and their importance must be recognized and their impacts controlled.

3.3 WATER QUALITY OBJECTIVES

Water quality is a general reflection of the health of a body of water. It is defined by the levels of such variables as the amount of oxygen dissolved in the water, suspended solids (e.g., silt), bacteria, toxic chemicals and nutrients such as nitrates and phosphates. Water quality will be affected by a number of features such as the terrain the river is flowing through, the time of year, the amount of runoff, and the type of effluent the river receives from sewage treatment plants and industry. Because of this and because of the different needs of society throughout the river basin, the water quality of the Bow River varies from reach to reach. From a management perspective this means that reach-specific priorities for water use must be established.

The Task Force has developed, according to water use, the following water quality objectives that should be used in management strategies developed on a reach-specific basis:

The Bow River is renowned for its large and plentiful wild trout.

Municipal and Domestic Water Supply

- achieve, with a minimum of treatment, drinking waters that meet or exceed the Canadian Drinking Water Guidelines; e.g., waters must be free of harmful levels of bacteria and viruses, toxic chemicals and trace metals

Recreation and Aesthetic Enjoyment

- maintain a high degree of water clarity and quality with a very low risk of bacterial or viral infection
- limit weed and algal growth and eliminate any odour or oily sheen and hazardous chemicals
- maintain the river and its banks free of litter

Ecosystem

Three ecosystems are affected.

In the cold water aquatic ecosystem the objectives are:

- maintain high oxygen content and cool water temperatures to ensure a diverse cold water plant and invertebrate community
- maintain a non-toxic environment for aquatic life
- ensure fish have no unpleasant taste or odour and fall within the guidelines for human consumption

In the warm water aquatic ecosystem the objectives are:

- maintain a non-toxic environment with moderate water temperatures and moderate oxygen content
- maintain a diverse warm water plant and invertebrate community
- ensure fish have no unpleasant taste or odour and fall within the guidelines for human consumption

In the wildlife ecosystem the objectives are:

- maintain a healthy environment, which will be met by satisfying the aquatic ecosystem requirements.

Agriculture

Water quality throughout the Basin should be non-limiting to agricultural use.

For irrigation the objectives are:

- maintain a low salt content
- maintain trace metal and herbicide levels that are non-toxic to plant growth
- eliminate bioaccumulative contaminants and pathogenic organisms
- reduce nutrient levels so they do not stimulate nuisance plant growth in the rivers or conveyance canals

For livestock watering the objectives are:

- prevent any bioaccumulative contaminants or pathogenic organisms from developing
- maintain low to moderate salt content
- maintain non-toxic levels of nitrogen, pesticides and trace metals
- maintain nutrient levels that do not stimulate growth of toxic blue-green algae

Water Disposal

- meet water disposal standards (municipal and industrial effluent and urban and rural runoff) that are based on the river's waste assimilation capacity and the most sensitive downstream water uses. Requirements in Banff National Park may impose other restrictions for waste disposal.

Industry

- maintain a water quality that is usable by industry. Weed and algal growth should not impair water withdrawal.

Hydropower Generation

Hydropower production has no specific water quality requirements. However, reservoir water releases must be coordinated with the water quality and quantity needs of downstream users.

4.1 WATER QUALITY MANAGEMENT

Except on federal lands, Alberta Environment has primary responsibility for wise use, protection and, where necessary, improvement of the environment, of which the quality of our water is a very important element. Alberta Environment is also responsible for coordinating the environmental activities of several other provincial government departments. In addition to the provincial mandate for environmental protection, several federal government departments and both urban and rural municipal governments have specific responsibilities. A summary of the water quality management activities carried out by government agencies with a legislative mandate for water quality management is shown in Table 1. The table indicates the following:

1 Water quality management is complex, involving a number of interrelated activities.

2 A multitude of federal and provincial government agencies and municipalities are involved in water quality management in the Bow River Basin.

3 No single agency has exclusive responsibility for all water management activities in the Basin.

The responsibility for water quality management goes beyond government agencies and involves industries, interest groups and the general public.

Alberta Environment is currently reviewing and revising its water management and environmental protection policies, legislation and regulations. The Department has designed an extensive public information and consultation program into the review and revision process. The Environmental Protection and Enhancement Act was introduced to the Legislature in June 1991. The public consultation process for the development of regulations for the new legislation was initiated in July 1991. Also in July, the public consultation process for review of water management policies and the Water Resources Act was initiated.

An overview of key activities in water quality management and the agencies involved in conducting these activities follows.

4.1.1 Monitoring

A number of agencies, including federal, provincial, and municipal governments, irrigation districts, and industries are currently conducting water quality monitoring programs in the Bow River Basin. Environment Canada is responsible for monitoring water quality conditions in Banff National Park. It maintains two long-term monitoring stations on the Bow River upstream of Lake Louise and Canmore. Water at these sites is sampled monthly, and is analyzed for a number of water quality parameters. Data obtained from these sites are stored in a computer database maintained by Environment Canada. In conjunction with the Banff Warden Service, Environment Canada also monitors bacteria in surface water in Banff National Park.

Alberta Environment has a number of ongoing programs to monitor water quality in the Bow River. It maintains a network of three long-term monitoring stations on the Bow River near Cochrane, Carseland and Ronalane. Each site is sampled monthly. Sampling programs are also in place to

Table 1

Government Agencies with Water Management Responsibilities in the Bow River Basin

	PROVINCIAL GOVERNMENT							FEDERAL GOVERNMENT				MUNICIPALITIES	
	Environment	Agriculture	Health	Labour	Forestry, Lands and Wildlife	NRCB/ERCB*	Transportation and Utilities	Environment	Canadian Parks Service	Fisheries and Oceans	DIAND**/ Indian Reserves	Rural Municipalities	Urban Municipalities
Planning	■	■						■	■		■		
Monitoring	■	■	■		■			■	■		■		■
Set Standards	■		■	■	■			■	■		■	■	■
Permits and Licenses	■			■	■	■		■	■		■	■	■
Enforcement	■		■	■	■			■	■	■	■	■	■
Emergency Response	■		■						■		■	■	■
Environmental Assessment: Conduct	■								■				
Environmental Assessment: Evaluate	■				■	■		■	■				
Land Use Controls					■				■		■	■	■
Water Treatment									■		■		■
Sewage Treatment									■		■		■
Funding	■						■	■	■		■		■
Operations of Works	■								■		■		■
Water Allocation	■												

* *Natural Resources Conservation Board/Energy Resources Conservation Board*

** *Department of Indian Affairs and Northern Development*

Figure 3. Water Quality Monitoring Sites

assess the effect of phosphorus removal at Calgary's sewage treatment plants, monitor the effect of groundwater contamination at the Canada Creosote site in Calgary, evaluate the effects of golf course runoff, and monitor treated drinking water supplies. As a result of these and previous sampling efforts, a total of 127 different sites have been sampled by Alberta Environment since 1985; each site has been sampled from one to 93 times. Twenty-three of the sites were located on the Bow River, 85 on tributaries to the Bow River, 14 in irrigation canals, and five in reservoirs and lakes (Figure 3). Water quality data from these sampling programs are stored in a computer database maintained by Alberta Environment.

Municipalities that use surface water for either drinking water supplies or wastewater disposal maintain monitoring programs for selected parameters as part of the operational and regulatory requirements for their water treatment and wastewater treatment facilities. Similarly, all licensed industrial discharges within the Basin are self-monitored and the results reported to Alberta Environment according to regulatory requirements.

The Eastern Irrigation District monitors the Bow River at Bassano for coliform bacteria during the irrigation season.

4.1.2 Planning

Alberta Environment has completed the South Saskatchewan River Basin Planning Program to address various water management policy issues in the South Saskatchewan River Basin, which includes the Red Deer, Bow and Oldman Rivers. Government policy decisions were announced in May 1990. Most significant among the policy decisions were 1) the intent to establish minimum and preferred instream flow requirements for individual river reaches to protect water quality and instream uses such as boating, angling and swimming, and 2) the intent to establish the maximum water allocation for irrigation purposes, with consideration for the needs of all other uses.

Implementation of the policy decisions in the Bow River Basin will require more detailed planning. Work has been initiated in priority areas such as instream flow requirements along the lower Highwood River and irrigation expansion guidelines. Further work is required to address other matters including reach-specific water quality objectives, instream flow requirements, flow regulation alternatives, and water allocation guidelines.

Several other agencies are involved in water management planning. Alberta Agriculture works with irrigation districts in planning water delivery and drainage works. The Canadian Parks Service plans water supply and waste water treatment facilities in Banff National Park. The Department of Indian Affairs and Northern Development (DIAND) works with Indian bands on planning for water supply and sewage facilities as well as land use and development on Indian reserves. Environment Canada administers the Canada Water Act and participates with the provinces in water management planning, primarily in interprovincial and international water courses.

4.1.3 Impact Assessment

Alberta Environment has an environmental impact assessment (EIA) process that ensures all major projects and those with potential for adverse environmental impacts will be reviewed to determine their environmental consequences before they are given approval to proceed. The process involves screening project proposals to determine whether or not an EIA report is required, determining the scope and content of EIA reports, coordinating an interdepartmental review of the reports and ensuring meaningful public involvement throughout the EIA process.

Under the new environmental legislation, projects on a mandatory list will be referred to a public process conducted by the Energy Resources Conservation Board (ERCB) for energy related projects or by the Natural Resources Conservation Board (NRCB) for other types of projects. The ERCB or NRCB will either reject projects as proposed or submit them for further consideration under Alberta Environment's licensing and permitting process. Projects not on the mandatory list will be reviewed by Alberta Environment and may be directed to the ERCB or NRCB process at the discretion of the Minister of Environment.

The Canadian Parks Service, under authority of the National Parks Act, conducts environmental impact assessments on activities proposed by the federal government and evaluates the environmental acceptability of private and public initiatives within Banff National Park. Environment Canada administers the Environmental Assessment Review Process and will administer the new Canadian Environmental Protection Act to prevent or control environmental impacts on federal lands, facilities and resources.

4.1.4 Permits and Licences

Alberta Environment's permitting and licensing process is a key component of water quality protection in the province. With respect to municipal and industrial effluent discharges, the process involves establishing standards for effluent quality, reviewing municipal and industrial applications for permits and licences to determine if standards can be met, inspecting projects and monitoring effluent to assure that performance is acceptable, and enforcing compliance with licence and permit conditions using a variety of persuasive and legislative options.

Effluent standards are generally based upon best practical technology for wastewater treatment plants. Where application of best practical technology does not maintain the desired level of water quality in the receiving stream, more stringent standards are imposed. If standards cannot be met, licences or permits will not be issued and the project cannot be operated.

In the past, there has been little or no public involvement in the permitting and licensing process for municipal and industrial projects. The new Environmental Protection and Enhancement Act calls for public notice and consideration of public comments at various stages in the approval process. The new act will establish an Environmental Appeal Board that will provide an independent review of

Department decisions on approvals, certificates and enforcement orders that are objected to by the directly affected public.

Alberta Environment also controls water allocations and uses through a licensing process.

As noted in Table 1, several other agencies are involved in issuing licenses and permits in the Bow River Basin. Alberta Labour issues permits related to private sewage disposal systems under the Plumbing and Drainage Act. The NRCB, ERCB, The Canadian Parks Service and Environment Canada have responsibilities to evaluate and approve environmental impact assessments. Municipalities, both urban and rural, control land use and development within their boundaries primarily through permitting processes. Land use and development on Indian reserves and in national parks is controlled by DIAND (with input from the Indian bands) and the Canadian Parks Service, respectively.

4.1.5 Enforcement

Enforcement of legislation and regulatory provisions for water quality management involves a variety of techniques including negotiations, legislative provisions, such as cancellations and enforcement orders, prosecutions and penalties. Table 1 shows agencies involved in various aspects of enforcement activities.

Alberta Environment currently enforces the provisions of several environmental acts, soon to be combined under the new Environmental Protection and Enhancement Act. Alberta Environment's permitting and licensing system is the key mechanism for pollution control in Alberta. Enforcement involves monitoring programs to ensure compliance and responding to non-compliance using various administrative and legal procedures.

Alberta Health and regional health units enforce the Public Health Act. The Act includes requirements for the keeping of livestock and waste management to ensure safe water for drinking and recreation. Alberta Labour enforces the Plumbing and Drainage Act to ensure, among other things, that private sewage disposal fields and septic systems are designed and constructed to ensure a safe environment for the public. Alberta Forestry, Lands and Wildlife works with the federal Department of Fisheries and Oceans to enforce provisions of the Federal Fisheries Act to protect the environmental quality of all waters frequented by fish.

Rural and urban municipalities enforce land use and development control bylaws within their jurisdictions. The National Parks Service, DIAND and Environment Canada enforce land use and development controls and standards for environmental protection on federal lands within their respective areas of jurisdiction.

4.2 PROBLEMS WITH WATER QUALITY

Existing problems with the water quality along the Bow River were determined by obtaining first hand information from Task Force members, testing data from river and drinking water monitoring programs against available water quality objectives and guidelines, and by reviewing studies. The Task

Force also monitored the river for bacteriological indicators.

The Task Force is very concerned about the presence of pathogenic bacteria, viruses and parasites all along the river, especially in reaches downstream of Calgary. These bacteriological contaminants have an impact on the use of the river for domestic supply, recreation and irrigation. Organic contaminants from the Canada Creosote site are measurable in river reaches 4 and 5. Their immediate impact on water supplies and the Bow River fishery does not appear to be significant, but this issue requires close ongoing surveillance. Treated drinking water from municipal supplies throughout the Basin generally satisfies the Canadian Drinking Water Guidelines for health parameters.

At low river flows night-time oxygen levels in the Bow River downstream of Calgary sometimes do not meet existing guidelines. The full significance of this must be further evaluated. Another emerging issue is potential toxicity to fish from ammonia in sewage discharges.

Calgary city centre on the banks of the Bow.

Below Calgary, levels of the plant nutrient, phosphorus, were drastically reduced in 1983 as a result of improved sewage treatment. However, over the last eight years increased sewage flows have allowed concentrations to increase again, although not to the levels observed in the late 1970s. Phosphorus levels in lower river reaches often exceed published guidelines, and nuisance levels of aquatic plants in the river can still occur in low flow periods. High phosphate levels also promote weed growth in irrigation canals. High levels of nitrate can also promote weed growth, but no eutrophication-based water quality guidelines are available. Nitrate levels in the river remain well below health-related guidelines.

The following sections describe in more detail the existing problems with water quality and how they affect specific water uses. Water quality problems, pollution sources and recommendations for improvement are presented on a reach-specific basis in Appendix III.

4.2.1 Municipal and Domestic Water Supply

The Bow River and its tributary streams, along with the water diverted to the three irrigation districts, are a drinking water source for the majority of the Basin. Major urban centres monitor their own water supplies, while Alberta Environment and the local authorities monitor treated water in the smaller municipalities. In all cases the monitoring records indicate that municipalities are in compliance with Canadian Drinking Water Guidelines for health parameters. In some cases the colour or taste of the water is affected but there are no associated health risks (see Technical Appendix VI for details).

Almost any surface water can be treated so that it is drinkable. Waters of poor quality, of course, require more extensive and expensive treatment. The primary objective of drinking water treatment technology has been the control of pathogenic bacteria and viruses. The poorer the quality of the source water, the greater the number of steps that must be incorporated into the treatment process, and the greater the risk that complete removal of all contaminant will not be achieved. It is to the

benefit of the citizens of the Bow River Basin from both an economic and health risk perspective to maintain the Bow River in as natural and unpolluted a state as possible.

With the exception of pathogenic bacteria and protozoans, the raw water quality of the upper reaches of the river essentially meet the Canadian Drinking Water Guidelines. Because of the risk of bacterial contamination from warm-blooded animals all surface waters in the Basin must be well disinfected before drinking.

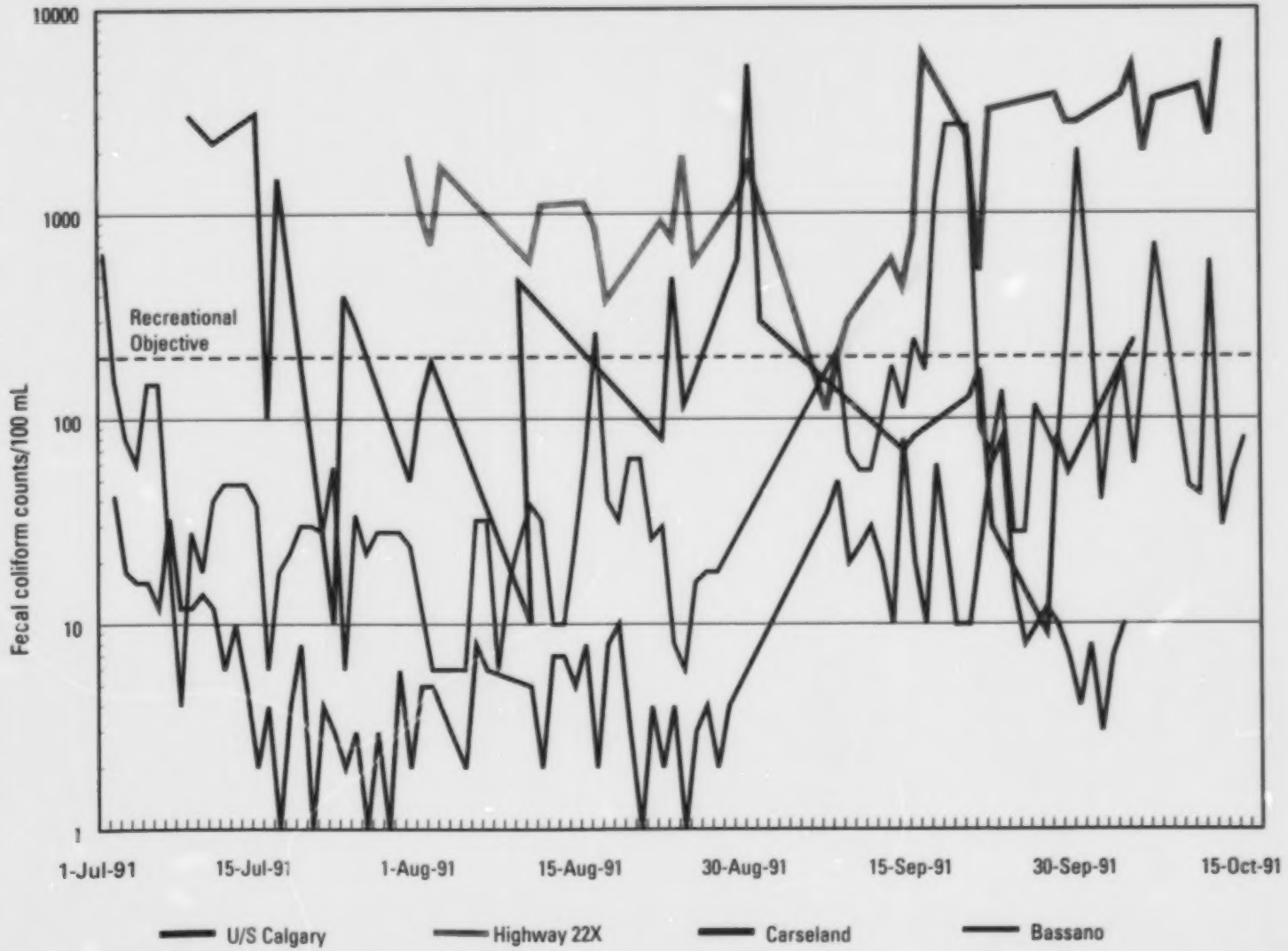
As one moves down the Basin bacterial levels and particulate materials increase and the river water needs more advanced treatment. These contaminants are derived from both natural and man-made sources. Below Calgary, in addition to bacterial contamination, increased nutrients and associated plant growth increase the organic content of the river. Conventional water treatment, which includes pre-sedimentation, filtration and disinfection, can effectively treat these waters to safe levels. However, by-products of excessive algal growth can cause taste and odour in drinking water when they react with the chemicals used in the chlorination process. Within the Basin, taste and odour problems related to excessive weed and algal growth are not substantial, but they do occur.

Few sources of complex industrial contaminants within the Basin discharge directly into the river, and all industries treat their water before discharge. Industrial pollution in the Calgary urban area is largely discharged to the Calgary sewage system, which then provides advanced treatment before river disposal. Within Calgary and immediately downstream there are, however, measurable levels of pentachlorophenol (PCP) and some polycyclic aromatic hydrocarbons (PAHs), notably naphthalene and benzo(a)pyrene. Concentrations are extremely low, in the part per billion range, and their lack of persistence in the river is such that within a short distance of the City of Calgary, they are no longer detectable. A preliminary health risk assessment conducted in 1990 indicates the most probable source is the abandoned Canada Creosote site and the risk to downstream water supplies is not significant. Additional risk assessments are currently being conducted.

4.2.2 Aquatic Ecosystem

Because of the pristine nature of the upper Bow River Basin there is no water quality based limitation to its cold water fishery. Within the Calgary city limits, and downstream to a point somewhere below Carseland, the river supports a world-renowned rainbow and brown trout fishery. This occurs in a zone that receives the treated effluent from the City of Calgary, and the nutrient enrichment from this sewage is likely a factor contributing to the size and quantity of fish present. In the late 1970s there was concern that this fishery could be affected by excessive weed and algal growth. Weeds depress river oxygen levels at night. Since the advent of phosphorus removal from sewage at Calgary in 1983, the weed situation has improved, especially in high flow years. However, in low flow years, nighttime minimum

Figure 4. Bow River Fecal Coliform Levels (July to October 1991)



Source: Bow River Water Quality Task Force

oxygen levels can still fall below the existing Alberta Surface Water Quality Objective of 5.0 mg/L. This has been observed in early spring and again in late summer but has not caused fish kills. The significance of these low values should be investigated.

River ammonia levels increase below the Calgary sewage treatment plants. During summer, when water temperature and pH levels in the river are naturally elevated, high concentrations of ammonia nitrogen can be toxic. In recent years, toxic levels have not been observed. However, because of ongoing growth in Calgary sewage discharges, this should be flagged as an emerging issue.

In the Calgary area, PAHs and PCPs have been detected in fish flesh. Existing data indicate levels have remained lower than health advisory limits. The source of these pollutants is thought to be industrially contaminated groundwater. Certain trace metal guidelines for aquatic life are occasionally exceeded in the Bow River; however, they are not toxic under pH and hardness conditions prevalent in the Bow River. These guidelines are subject to further clarification.

In the lower Bow River, the aquatic ecosystem is dominated by warm water fish species. Potential water quality limitation of this fishery is not well understood, due to lack of monitoring. Downstream of Bassano, there is a mercury advisory which limits consumption of walleye and northern pike. This advisory is common to the lower reaches of many Alberta rivers. The mercury is considered to be derived from natural sources.

It is important to realize that all life in the river is interrelated. A healthy aquatic ecosystem is fragile. If one part of it is upset then another aspect will be affected. We must therefore strive to protect all ecosystem components.

4.2.3 Recreation and Aesthetic Enjoyment

A major concern with respect to use of the Bow River for contact recreation (swimming, boating, fishing) is high levels of pathogenic bacteria, as measured by the fecal coliform indicator test. Upstream of Calgary a chronic problem with coliform contamination below Banff has recently been alleviated through construction of a new sewage treatment plant, which has disinfection (as do all sewage treatment plants in the National Park). Sewage discharges are not disinfected in the Canmore Corridor and loadings will potentially increase significantly with anticipated population growth.

At Cochrane and above Calgary, coliform densities in the river are still low, but they have been slowly increasing in the last few years. Below Calgary, fecal coliform counts exceed the recreation guideline on a regular basis as far downstream as Carseland (Figure 4). At the Bassano diversion to the EID the 200 count per 100 mL fecal coliform limit is also exceeded on several occasions per year. The two sewage treatment plants at Calgary do not currently disinfect and fecal coliforms also enter the river in urban and agricultural runoff.

From both an aesthetic and recreational perspective, excessive numbers of aquatic plants can be an impairment. This is generally not an issue

upstream of Calgary. Below the City, weed growth has been an issue for many years and improvements have been observed. However, in low flow years excessive levels can still occur despite nutrient removal at Calgary sewage treatment plants.

Within reservoirs and lakes served by the irrigation districts, excessive weed growth can also be an impairment to recreation. This problem is especially noticeable in the case of Chestermere Lake. It receives water from Alberta Environment's main canal leading to the WID. This canal is contaminated with runoff from the City of Calgary and other upstream areas.

In general, aesthetic enjoyment of the Bow River depends on maintaining a healthy ecosystem in the river and its surrounding environment.

Weeds in irrigation canals are an annual maintenance expense.

Littering of the Bow River and its banks is an ongoing problem, especially within the urbanized areas. The source of this litter is not just the general urban environment; recreationists and rural residents are also contributors.

4.2.4 Agricultural Water Use

Water quality factors affecting agricultural water use include salt content, presence of pathogenic bacteria, excessive nutrient levels that promote weed and algal growth in canals and reservoirs, and suspended solids that deposit as silt in canals. The major agricultural water use of the Bow River occurs below Calgary. Upstream of Calgary the primary use is livestock watering, and no water quality limitations have been identified.

Downstream of Calgary, at the diversions to the Bow River Irrigation District and Eastern Irrigation District, fecal coliform levels frequently exceed normal irrigation guideline limits. As well, weed growth and siltation of irrigation district canals and reservoirs is a pervasive problem. This cannot be entirely attributed to high nutrient and suspended solids in the Bow River; however, it is probable that elevated phosphorus levels below Calgary do contribute to the situation. Siltation is a problem in the WID main canal and in Chestermere Lake. Calgary stormwater runoff into the WID canal and Nose Creek contribute to this siltation.

4.2.5 Industrial Water Use

Industries that withdraw water directly from the Bow River are not typically affected by existing water quality conditions in the Bow. Historically, their major concern has been clogging of water intakes with weeds. This still occurs in low flow years.

4.3 POLLUTANT SOURCES

The Bow River has two major sources of pollutants – direct and indirect. Direct sources discharge pollutants at specific points along the Bow River and its tributaries and include municipal and industrial effluents, storm sewer discharges, and irrigation return flows. Indirect sources, on the other hand, contribute pollutants via diffuse pathways such as groundwater and non-channelized surface runoff. These indirect sources include contaminated groundwater seepage from industrial sites and landfills, and runoff from agriculture and to a lesser degree golf courses.

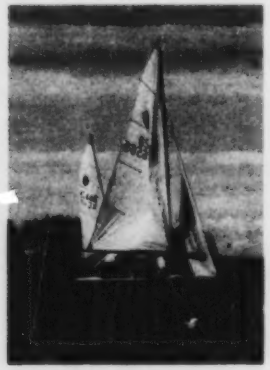
Municipal effluents, particularly from the City of Calgary, are the largest single source of nutrients, coliform bacteria, and some toxic substances (e.g., ammonia) to the Bow River. By comparison, pollutant loads from industrial effluents discharging directly to the Bow River are negligible.

Urban runoff from Banff, Canmore, Cochrane, and especially Calgary is a source of nutrients, coliforms, metals, salts, suspended solids, and other contaminants to the Bow River. Following heavy storms, elevated levels of some of these contaminants will occur in the river downstream of these centres; however, insufficient data currently exist to provide a good understanding of the magnitude of this impact.

Agricultural activities are important throughout most of the mid and lower reaches of the Basin. Nutrients, coliform bacteria, and pesticides are generated from intensive livestock operations and crop production. However, insufficient information currently exists to determine the impact of agriculture runoff on the water quality of the Bow River.

Contaminated groundwater from industries and landfills is of increasing concern. Studies have demonstrated that creosote is seeping into the river from the abandoned Canada Creosote site in northwest Calgary. Other contaminated sites have been identified, but their risks to the Bow River have not yet been assessed.

Preliminary findings from a study being conducted by Alberta Environment indicate runoff from golf courses in the Basin has minimal impact on surface water quality.



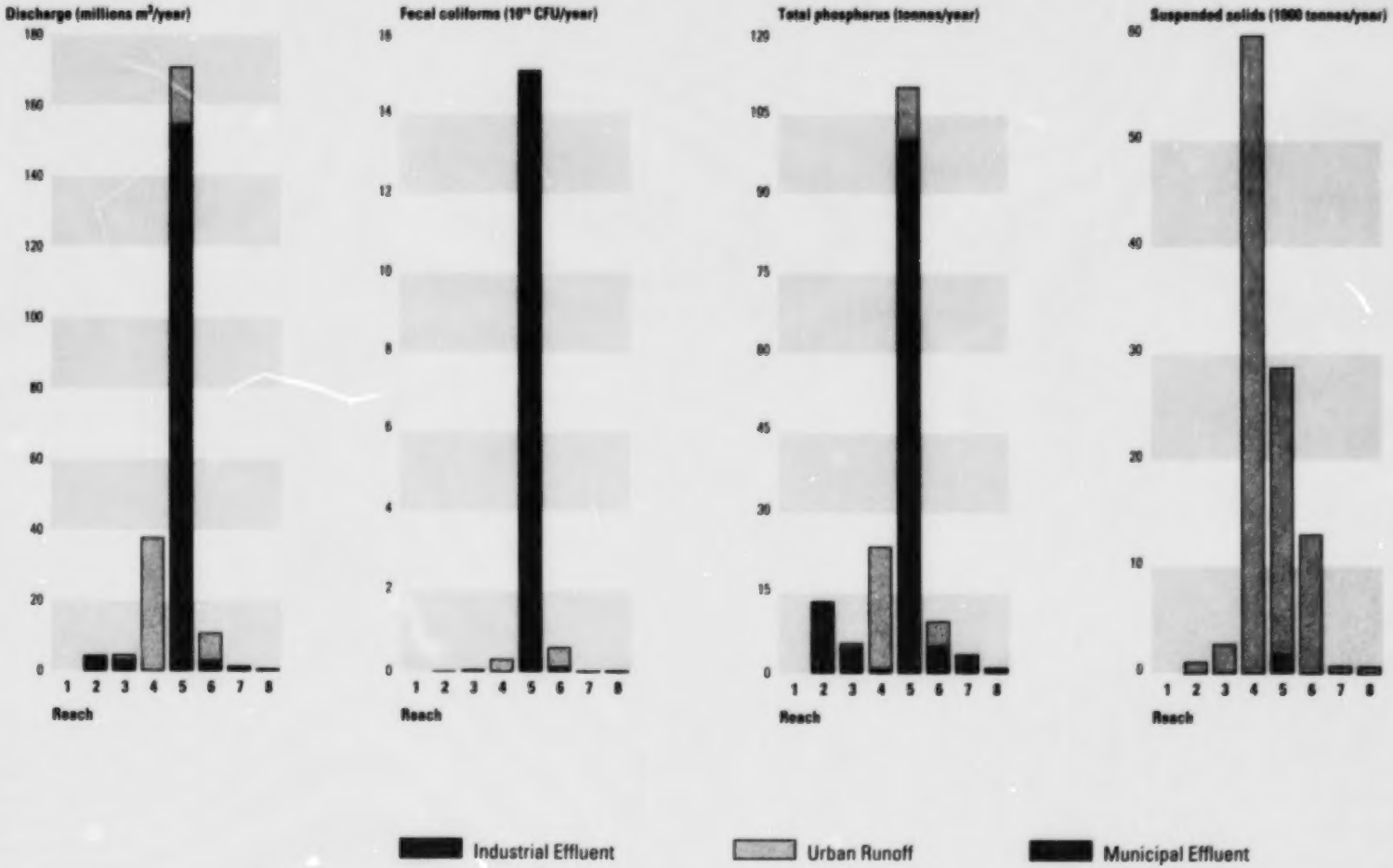
Chestermere Lake is one of many recreational lakes fed from the Bow River.

4.3.1 Municipal and Industrial Effluents

Approximately 50 municipalities are licensed to discharge treated wastewater within the Bow River Basin. The City of Calgary's Bonnybrook and Fish Creek wastewater treatment plants account for nearly 90% of the total volume of wastewater that enters the Bow River and its tributaries.

All municipal wastewater facilities in the Bow River Basin provide a minimum of secondary treatment. Historical problems with high coliform bacteria levels in the Bow River downstream of

Figure 5. Average Annual Effluent Discharge Volumes and Fecal Coliform, Total Phosphorus and Suspended Solid Loads from Direct Discharges to the Bow River and its Tributaries



Banff have been largely rectified by a new plant completed by the town in 1989. The new plant includes disinfection of its effluent (as do the other sewage treatment plants in Banff National Park, Kananaskis, and Cochrane). There are, however, still problems related to municipal sewage from Canmore. High water levels in the river occasionally cause flooding of the sewage lift stations, which results in the release of untreated sewage to the river.

The City of Calgary's two wastewater treatment facilities are among the most advanced in Canada. Since 1983, both plants have incorporated tertiary treatment for chemical removal of phosphorus. The City of Calgary is presently upgrading the Bonnybrook plant (which treats 75% of Calgary's sewage) to include non-chlorine disinfection by 1994, nitrification of ammonia, and biological rather than chemical phosphorus removal.

Even though there is a high level of municipal wastewater treatment, municipal effluents still contain high levels of coliform bacteria, nutrients, and toxins (e.g., ammonia). By far the largest direct source of these pollutants to the Bow River is Calgary's wastewater treatment plants, as shown in Figure 5. Thus, water quality problems related to municipal effluents are most noticeable in the river reaches immediately downstream of Calgary.

Only five industries are licensed to discharge wastewaters directly to the Bow River or its tributaries, a cement plant at Exshaw, gas plants at Jumping Pound and near Cochrane, and two fertilizer plants at Calgary. Relative to municipal discharges, both the volume and pollutant loads from these effluents are low and are not a major concern with respect to water quality of the Bow River (Figure 5).

4.3.2 Urban Runoff

There has been increased attention in recent years on the potential impact of urban runoff on surface water quality. Material that accumulates on streets and other surfaces is carried by rain and snow-melt water through a storm drainage system to receiving streams and rivers.

Only a small fraction of the Basin will contribute urban runoff to the Bow River, as urban areas account for less than 3% of the total Basin area. Calgary accounts for approximately 85% of the total urban area. Of the total area contributing urban runoff from Calgary (32,000 hectares), currently 40% (12,800 hectares) receives some level of treatment.

Even though the contributing area for urban runoff is small compared to the total Basin area, the major urban centres of Banff, Canmore, Cochrane, and Calgary are all located on the Bow River. Thus, runoff from these municipalities will enter the river directly. Studies conducted by the City of Calgary indicate that storm sewers contain high levels of coliform bacteria, nutrients, some metals, salts, suspended solids, and other pollutants, which will contribute to elevated levels of these contaminants in the Bow River. In addition, high suspended solid loads from urban and agricultural runoff into Nose Creek, which enters the Bow River immediately upstream of the WID weir, and direct discharges to the WID diversion canal from east Calgary are

contributing to sediment problems in Chestermere Lake. Towns like High River and Okotoks drain to the sub-watershed, in this case the Highwood and Sheep Rivers.

On an annual basis, urban runoff from Banff, Canmore, Cochrane and Calgary is the largest direct source of suspended solids in the Bow River (Figure 5). In addition, urban runoff is a larger source of coliform bacteria and phosphorus pollutants than industrial effluents but a smaller source than municipal effluents. However, pollutant loading from urban runoff occurs over short-time periods following storms and snow melt. At those times it may be the most significant source of pollutants to the river. Too little data exists to accurately quantify the impact of storm runoff on the water quality of the Bow River.

4.3.3 Agricultural Runoff

Runoff from intensive livestock operations is a potential source of coliform bacteria and nutrients to the Bow River. Best estimates indicate there are approximately 450,000 cattle, 230,000 market hogs, 25,000 sheep, and 250,000 poultry within the Bow River Basin (see Appendix VI). Most of the intensive livestock operations are concentrated in the middle and lower portions of the Basin. In addition, approximately 65% of the Bow River Basin is used for farmland, which is also a potential source of nutrients and pesticides to the river. The extent of farmland increases from west to east along the Basin; the mountain and foothill reaches have little or no agricultural activity while the lower reaches are extensively farmed.

Livestock within the Basin generates enormous amounts of wastes. However, in contrast to direct sources of pollutants, such as municipal effluents, only a very small portion of the total amount of pollutants generated by livestock will actually enter the Bow River. Processes such as uptake of nutrients by plants, breakdown of pesticides, and bacterial decay will substantially reduce amounts of these pollutants before they are transported to the Bow River. At present, not enough information is available to quantify the impact of agricultural runoff on the Bow River. It is probable, however, given the large amounts of waste generated, that runoff from intensive livestock operations will have adverse effects, particularly on smaller streams adjacent to these operations.

In addition to intensive livestock operations, runoff from crop and pasture land generates nutrients, pesticides, and silt. However, like intensive livestock operations, only a small portion of the amount generated from farmlands will actually be transported to the Bow River. Present data are insufficient to quantify the effect of farmland runoff on the water quality of the Bow River.

4.3.4 Golf Courses

In the Bow River Basin there are about 50 golf courses (30 in the Calgary region alone) and another 15-20 proposed courses. Studies in other regions of North America have noted surface water contamination of nutrients and pesticides from

golf course runoff. However, in the Bow River Basin the amount of nitrogen, phosphorus, and pesticides used by golf courses is limited relative to that applied to agricultural fields and urban green spaces. Preliminary findings from an ongoing monitoring program conducted by Alberta Environment have not identified any problems with nutrients or pesticides in surface waters adjacent to the golf courses that have been studied to date.

4.3.5 Contaminated Groundwater

The Canada Creosote site adjacent to the Bow River in north-west Calgary is the most prominently known contaminated groundwater site in the Bow River Basin. Wood preservative operations were carried out at that site from 1924 to 1962. Investigation of the site in 1988-89 by Alberta Environment revealed that considerable amounts of creosote are lying on top of the bedrock, and a substantial portion of that is situated directly under the river. Water, sediment, and fish samples have indicated that contaminants from that site are seeping into the Bow River. Even so, a preliminary risk assessment of the site conducted in 1990 indicates that fish and wildlife are not at risk downstream of the site and there is no significant human health risk for downstream users. Additional studies are in progress to provide information to assess clean-up options.

The Help End Landfill Pollution (HELP) program has identified other sites in the Bow River Basin that contain contaminated groundwater. Further work is necessary to determine whether those sites, and other potential sites not covered by the HELP program, are contributing pollutants to the Bow River.

5.0 Recommendations

This section of the report documents the major recommendations of the Task Force. Specific recommendations pertinent to each river reach are summarized in Appendix III.

5.1 BOW RIVER WATER QUALITY COUNCIL

Responsibilities for water quality monitoring, protection and enforcement are shared among several federal and provincial government departments and the municipalities in the Basin. No one agency has overall responsibility for water quality protection for the entire river system. The responsibilities of the various agencies involved have not been well publicized.

In general, agencies involved in water quality protection have developed considerable expertise related to their respective areas of jurisdiction. This expertise should be retained within these agencies. However, the Task Force feels that an advisory body is needed to foster co-operation, consistency and efficiency among agencies, to provide a link between government agencies and the general public, to focus public and political attention on water quality issues, and to stimulate action where action is needed.

5.1.1 Establish a Water Quality Council

The Task Force recommends that a permanent independent Bow River Water Quality Council be established reporting directly to the Minister of Environment. The primary purpose of the Council would be to promote awareness, improvement and protection of Bow River water quality.

Membership

The Council would be a stakeholders group of water users consisting of representatives of urban and rural municipalities, irrigation districts, industries, special interest groups, Indian reserves and parks in the Basin. The stakeholder groups represented on the Council would be chosen by the Minister of Environment, with the groups then selecting their members.

Level of Authority

The Council would be an independent body reporting directly to the Minister of Environment. The Council would make recommendations to the Minister on policy and program issues related to Bow River water quality improvement and protection. It would also provide links among governments, stakeholders and the general public. Its area of influence would extend to matters within the entire Bow River Basin that could have a significant effect on surface water quality. The Council must have access to all pertinent information and expertise within government departments.

Typical Duties

Typical duties would include:

1. Review the progress of and make public the follow-up work related to recommendations of the Bow River Water Quality Task Force.
2. Publish an annual State-of-the-River Report.
3. Review water quality monitoring programs and make recommendations to ensure they are

efficiently designed, coordinated among various agencies, complete and properly reported.

4 Review pollution control policies, programs, enforcement mechanisms and funding relating to water quality and, where gaps or weaknesses are identified, make recommendations on required improvements.

5 Develop positions on and make recommendations with respect to Environmental Impact Assessments, major development proposals, major water allocations, new legislation, and effluent permits pertaining to the Bow River Basin.

6 Review and make recommendations regarding planning programs relating to the Bow River Basin, recognizing the link between water quality and quantity. This may include review of instream flow needs studies, reach-specific water quality objectives, flow regulation studies, and water allocation guidelines.

7 Promote programs to increase public awareness of water quality issues in the Bow River Basin.

8 The Council would act as a repository and the public source of all studies and reports pertaining to water quality issues within the Bow River Basin. Appendix V lists the existing reports on water quality reviewed by the Task Force. These and all new reports should be filed with the Council at its office.

Costs

The Council should be headquartered in Calgary. It could have about 20 members and a permanent secretariat of two or three persons, one of which should be a water quality specialist. The Council would meet 10 to 12 times a year. Annual budget for the Council would be about $200,000.

5.2 SEWAGE TREATMENT

The Bow River has a finite ability to support its dependent human population. To maintain the river as an attractive living entity to be enjoyed and used by future generations, the Bow River Water Quality Task Force recognizes we must continue to develop and implement ever-improved strategies for sewage treatment. These strategies will focus on continued implementation of more advanced sewage treatment technologies. However, when feasible we should also strive to implement methodologies that remove the need for the Bow River to act as the point of final effluent disposal, and should consider ways of increasing the use of waste water

Bonnybrook sewage treatment plant in Calgary.

as a resource. We must also attempt to limit the quantity of sewage produced and change river flow regulation strategies to improve the river's assimilative capacity.

5.2.1 Identify the Bow River's Finite Assimilative Capacity

The Task Force recommends the identification of the capacity of each reach of the Bow River to receive municipal and industrial wasteloadings. These must then be compared with projected growth in wasteloadings so that effective long term effluent disposal strategies can be developed.

Using current data, we should undertake a study of the Bow River Basin to extrapolate effluent conditions for the next 50 years, assuming that the present level of use and development continue. Planning studies must define the maximum permissible level of total loadings each reach can reasonably receive and still protect existing water uses in the short term. In the long term they must define where loadings may have to be reduced to allow for water quality improvement. This exercise will clearly define where and when existing or future levels of treatment technology are inadequate, and where alternative sewage treatment strategies must be developed if population growth in the Basin is to continue without further deterioration of the river. This study would cost about $100,000.

5.2.2 Continued Advancement in Sewage Treatment Technology

The Task Force recommends that research into more advanced wastewater treatment technologies must continue and new technologies must be implemented so we can cope with the ever-expanding sewage volumes and tighter effluent restrictions.

To allow for continued growth on a river that is at or near its finite capacity to receive wastewaters, we must implement new technologies. For example, new procedures will soon be in place for disinfection, nitrification and biological removal of phosphorus at the Bonnybrook Sewage Treatment Plant. Monitoring must be in place to ensure the byproducts (e.g., nitrate) of these new procedures do not adversely affect downstream users. Research must continue to develop more effective and safe sewage treatment procedures. A continuing program to review the research and experimental efforts of other jurisdictions that face similar restrictions should be implemented. These new technologies must then be made operational in a timely manner.

Greater sewage treatment, however, invariably leads to increased sludge handling requirements. The City of Calgary, through its Calgro program, currently uses sludge as a soil nutrient. More research is needed to extend the uses of this semi-solid by-product.

5.2.3 Development of Regional Sewage Treatment Plants

The Task Force recommends that every opportunity should be taken to develop regional sewage

treatment plants serving more than one community. This would allow smaller centres to enjoy the benefits of more sophisticated and effective sewage treatment approaches.

Because the Bow River has a finite assimilative capacity, communities discharging effluent to the Bow River will have to implement more advanced levels of wastewater treatment as these communities grow. These treatment facilities are expensive to build and are technically complex in their operation, especially if high levels of effluent removal are to be achieved. Consequently, such facilities will require a relatively high population base to support their operation in a cost-effective manner.

For example, the Canmore Corridor is an area of immediate concern. Because the Canmore sewage treatment plant requires expansion and upgrading, due to projected substantial population growth, the Task Force believes an integrated approach to sewage treatment should be implemented for this region.

Regional treatment plants cannot be considered for all sites in the Basin. Where major new commercial developments occur in isolation from a regional facility, they must be required to treat their own sewage to accepted standards and to institute self-monitoring systems.

5.2.4 Alternative Sewage Disposal Strategies

The Task Force recommends that, where feasible, communities implement alternatives to river disposal for treated wastewaters to avoid increasing effluent loading to the Bow River.

As the population of the Basin increases we should pursue opportunities to handle some of the expansion in sewage volumes in a way that eliminates the need for disposal to the river. This applies to all municipalities throughout the Basin. Such technologies might include effluent irrigation, wetland treatment, and rapid infiltration. Effluent irrigation is currently in use in Strathmore. An example of wetland treatment is found in High River, where effluent is pumped to Frank Lake providing the secondary benefit of enhanced waterfowl habitat.

If these alternatives are implemented they could also benefit agricultural crop production, golf course irrigation, or wildlife habitat development. To implement these strategies we must first gain wider public acceptance and provide assurances that public health would not be compromised.

5.2.5 Universal Effluent Disinfection

The Task Force recommends that all direct municipal discharges to the Bow River be disinfected using methods that do not create unwanted by-products.

High levels of bacteriological indicators are a problem at various locations along the river. Although municipal discharges are not the only source, they are a major contributor that can be readily controlled. The Task Force recommends that Alberta Environment require all municipalities with direct river effluent discharges to disinfect for control of pathogenic bacteria, viruses and parasites. With respect to existing plants, this

means disinfection should be implemented at Canmore and at Calgary's Fish Creek sewage treatment plant. Disinfection at Bonnybrook Sewage Treatment Plant is scheduled to be implemented by 1994.

Health authorities are concerned about the use of chlorine as a disinfectant, therefore, alternate methods that do not create hazardous by-products should be selected.

5.2.6 Water Conservation to Control Sewage Volumes

The Task Force recommends that water conservation measures be implemented throughout the Basin to reduce both sewage effluent volumes and the cost of wastewater treatment, thereby providing both environmental and economic benefits.

Mandatory metering of all municipal water consumption is recommended.

Excessive municipal water use translates to greater volumes of sewage, which increases treatment costs and reduces pollutant removal efficiencies. Experience in other municipalities, such as Edmonton, indicates water conservation can significantly lower water treatment and disposal costs. Studies indicate this can be achieved by universal metering of residential, commercial and industrial water users and by establishing water charges based upon the amount used. In addition, new residential, commercial and industrial developments must incorporate water conservation technologies which should be enforced at the development approval stage. This should include items such as low volume shower heads and water closets. Provincial legislation should make universal water metering mandatory in municipalities. At the same time municipalities must develop bylaws and incentive programs to reduce excessive water consumption.

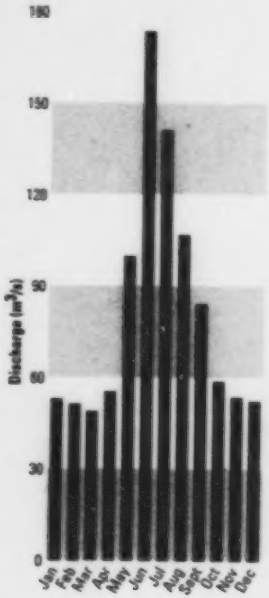
Implementation of these recommendations will require modification to existing regulations or new legislation.

5.2.7 Control of Pollutants at Source

The Task Force recommends that greater emphasis be placed on controlling industrial pollution and toxic contaminants at their source. This means tighter regulations and monitoring for industries that discharge to municipal treatment systems.

Most of the industries within the Basin now discharge to municipal treatment systems and are, therefore, not directly licensed by Alberta Environment. Many of these industries use or produce toxic and volatile chemicals. While current practices in major Alberta treatment facilities, like Calgary, seem able to cope with the presence of these fluids, they do place additional burdens on the facilities. For these chemicals, greater use of incineration and deep well injection should be considered. In addition, continued pressure on industry to limit use of toxic chemicals and do their own effluent treatment should be encouraged. Monitoring of these pollution sources should also be expanded. The direct cost of such monitoring should be borne by the industries. The indirect costs relating to review and enforcement should be covered by increased license fees.

Figure 6.
Average Daily Flows in the Bow River at Calgary (1980 - 1988)



To facilitate more stringent and consistent source control of industrial effluent, Alberta Environment should develop a uniform bylaw for municipal industrial discharges that should be adopted by all municipalities within the Basin. This could be modelled on programs such as Ontario's Municipal and Industry Strategy for Abatement (MISA) program and should consider control of emissions, treatment requirements and monitoring. More consistent municipal bylaws would reduce the threat of industries relocating from a municipality with stringent effluent standards to one with lower standards.

5.2.8 River Flow Regulation and Water Conservation

The Task Force recommends an investigation of alternative river flow regulation strategies in order to optimize and conserve the Bow River's use and assimilative capacity.

The capacity of the Bow River to assimilate waste loadings is primarily determined by river flows, particularly during late summer, fall and winter when flows are low (Figure 6). By increasing flows in those seasons, water quality improvement can be realized. This may be accomplished by revising the operational goals for the existing hydropower reservoirs in the upper Basin, by considering development of new reservoirs in off-stream locations such as within irrigation areas and by encouraging water conservation by all users throughout the Basin.

5.3 MONITORING

The health of the Bow River, the identification of present and emerging water quality issues and the effectiveness of pollution control measures can only be evaluated through proper water quality monitoring. The Task Force feels strongly that monitoring programs within the Basin must be expanded and effectively coordinated. Data from these monitoring programs must also be interpreted and reported to the Bow River Water Quality Council and the general public in a timely and effective manner. The Council should have direct input to the establishment of monitoring goals and objectives. These should be reviewed and updated on a regular basis.

5.3.1 Increased River Monitoring

The Task Force recommends existing river water quality monitoring programs be optimized and expanded so that river water quality can be tested against reach-specific water quality objectives and any emerging problems identified. In designing the expanded program, data collection activities from all agencies that sample water quality along the Bow River should be reviewed, coordinated and integrated to optimize resources. Data from this new expanded program will allow the Bow River Water Quality Council to produce an annual State-of-the-River report.

Reach-specific water quality objectives must be developed and approved. Neither the Alberta Surface Water Quality Objectives nor the Canadian

Water Quality Guidelines for surface water are appropriate for all parameters and in all river reaches. Objectives developed specifically for the Bow River must take into account natural changes in water quality, river biology and the changing water use patterns from the headwaters to the river mouth. A preliminary set of use-specific water quality objectives developed by the Bow River Water Quality Task Force (Appendix VI) provides a starting point for the development of suitable objectives.

The design of the new monitoring program should include documentation of current monitoring programs and development of information goals. This evaluation should consider all agencies that collect water quality data along the river and include recommendations to optimize existing programs to reduce costs and improve the quality of information obtained. For instance, routine sampling of raw and treated drinking water supplies for heavy metals and trace organic priority pollutants, which entail high analytical costs, may not be warranted given the existing level of treatment of drinking water supplies, the lack of detectable contaminants in previous samples, and the low probability that one sample per month (or year) would be adequate to detect non-compliance with water quality objectives. Similarly, the routine collection of water samples from the Bow River downstream of the Canada Creosote site, which are currently being analyzed for trace organic contaminants and toxicity, should be reassessed. Alternative sampling strategies such as the collection of time-integrated samples and/or measurement of contaminants on media such as suspended or bottom sediments may provide more useful information.

Expansion of the existing river monitoring network in terms of stations and sampling frequency is required to identify seasonal compliance patterns, for example, detection of impacts during a period of heavy rainfall. However, rigorous compliance monitoring at multiple stations on a daily or even more frequent basis is not cost effective. Even if such a program were implemented, it would likely still not detect the effects of short-term pollution events such as spills nor provide data suitable for legal prosecution. Rather than implementing daily compliance monitoring to identify spills, more effort should be directed at controlling pollution at the source.

The expanded monitoring program for the Bow River should be reviewed on an annual basis and revised to take into account changes in information requirements. It is anticipated that the design of the new monitoring program will cost $50,000, and the revised Bow River monitoring program will increase monitoring costs by approximately $125,000 per year.

5.3.2 State-of-the-River Reporting

The Task Force recommends that the status of water quality in the Bow River Basin be reported in an annual State-of-the-River report. The target audience of this report should be the general public.

Presently, regular reporting of water quality conditions in the Bow River is not being carried out. The reporting that does exist is not in a form readily

understood by the general public. The State-of-the-River report should be produced annually and written in a non-technical manner. The reports should clearly indicate the status of the river's water quality for the period of interest, note any changes in water quality over time, test for compliance with water quality objectives, discuss changes in contaminant sources and identify problems that should be addressed. In preparing the report, reliable data available from all agencies monitoring surface water quality in the Basin should be considered.

The focus of the State-of-the-River reports is to provide information to the general public. Thus, complex water quality data must be presented in a simple format. The use of water quality indices that represent the "health" of the Bow River in a concise and straight-forward manner, similar to those used for air quality indices or economic indicators, should be considered. Input from scientists, water managers and stakeholders is necessary for the development of appropriate water quality indices.

The Bow River Water Quality Council should decide upon the format of the annual State-of-the-River report. These reports should be prepared by the Council secretariat or its consultants and reviewed and published by the Council. It is estimated that State-of-the-River reports will cost about $50,000 per year to produce.

5.3.3 Centralized Water Quality Database

The Task Force recommends Alberta Environment establish a centralized water quality database for all agencies involved in data collection throughout Bow River Basin. This database should be readily accessible by any interested party.

Presently, the provincial NAQUADAT water quality database only contains data collected by Alberta Environment and Environment Canada. The database does not include information on municipal and industrial effluents (which are monitored as part of licence requirements), drinking water quality surveys, or surface water quality data collected by municipalities or other agencies such as health boards and irrigation districts. We recommend that Alberta Environment's database be expanded to included all reliable monitoring data pertinent to the Bow River. This database should be readily accessible by any interested party. It may be possible to implement this recommendation with Alberta Environment's existing resources. Should additional funds be required, a database user fee could be considered.

5.3.4 Investigation of Urban and Rural Runoff

The Task Force recommends the creation of a special monitoring program to determine the impact of urban and agricultural runoff on surface water quality in the Bow River Basin.

Urban Runoff The effect of urban runoff on the water quality of the Bow River has not been thoroughly addressed by existing monitoring programs. Investigation of urban runoff loadings of coliform bacteria, nutrients and trace metals requires a special monitoring initiative. Such a program should focus on storm sewer outfalls and river reaches within and downstream of Calgary.

The monitoring program must be designed to identify the relative effects of urban runoff, sewage loadings and agricultural runoff on water quality of the Bow River. It must also provide information about urban watersheds to assist in establishing priorities for implementing runoff control. Such a study would cost about $600,000 to conduct and would require two to five years to complete. Cost-sharing between the City of Calgary and Alberta Environment should be pursued.

b **Rural Runoff** Alberta Agriculture and Agriculture Canada are in the process of developing a five-year plan to study the extent of agriculturally related water quality impacts within Alberta. We strongly support this program and would recommend that some of this monitoring be conducted in the Bow River Basin. In particular, the monitoring program must address the potential impact of agricultural runoff on bacteria, nutrient, salt and pesticide levels in the Bow River. Assuming the program is well designed, and some portion is carried out within the Bow River Basin, we see no point in conducting a separate monitoring initiative specifically for the Bow River. The federal government Green Plan initiative is proposed as a source of funding for this program.

One of over 385 storm sewer outfalls in Calgary.

5.4 URBAN RUNOFF

The Bow River Water Quality Task Force is very concerned about the impacts of urban surface drainage on the water courses in the Bow River Basin. As indicated in Section 5.3.4, the extent of these problems is uncertain because historical monitoring and analysis programs have not fully addressed the issue. Urban runoff typically contains contaminants such as pesticides, fertilizers, animal wastes, petroleum products, road salts, silt and pollutants from combustion exhausts. Permissable levels of contaminants in urban runoff are currently unregulated in Alberta and continued urban growth will serve to aggravate existing conditions.

The Task Force believes enough information exists to recommend immediate action on a formal program of quality control of surface water runoff from new urban land development projects in the Bow River Basin. Runoff from new development is relatively easy to control at the design stage. At the same time, adverse affects on surface waters in the Bow River Basin from existing urban developments must be assessed to identify the needs, if any, for retrofitting existing storm water drainage systems.

Research and demonstration projects by the United States Environmental Protection Agency has resulted in the development of a program of management practices for the quality control of urban surface water runoff. All relevant components of that program should be considered for application in the Bow River Basin.

The Task Force also emphasizes the need for a program to increase public awareness of the importance of quality control of surface runoff in urban areas. Examples of urban runoff problem areas include the Western Irrigation District canal upstream of Chestermere Lake, the Nose Creek

Basin and urban areas draining to Glenmore Reservoir.

5.4.1 Quality Control of Runoff Water From New Urban Development

The Task Force recommends that urban municipalities throughout the Bow River Basin implement development bylaws and land use regulations to eliminate the effects of new urban land development on the quality of runoff water to the Bow River.

Surface runoff from the Calgary urban area exceeds the total runoff from all other communities in the Bow Basin and there appears to be runoff related water quality problems in Calgary and in the Bow River below Calgary. On this basis we recommend the City of Calgary take a leadership role in the research, development, and implementation of measures to control the quality of surface runoff. The Bow River Water Quality Council should implement a basin-wide program to encourage control and management of the quality of urban runoff.

Regulations for new land development or redevelopment should cover two phases. First is the **construction phase** when the site or area is vulnerable to serious erosion from uncontrolled runoff or wind. During this phase, developers should:

- restrict and phase the extent of topsoil stripping and grading to keep site vulnerability to a minimum,
- control off-site runoff flows and sedimentation by using benches, berms, temporary ponding areas or other appropriate means.

The second is the **post-construction** phase, which should control long-term water quality of runoff from the entire development site. The requirements of this phase involve design and incorporation of control measures at the master drainage or area-structure stage of the development process. Management practices for incorporating long-term control measures include:

- wet sedimentation ponds,
- natural or constructed wetlands,
- soil or groundwater infiltration,
- grassed swales and filter strips,
- secondary water uses such as irrigation,
- information/education materials for the development industry.

Experience shows that wet sedimentation ponds provide a significant level of contaminant removal and can provide water for uses such as golf course irrigation. However, at certain times of the year water quality can deteriorate in sedimentation ponds. Consequently, regular maintenance is required and should be recognized in the planning and budgeting processes.

The cost to implement runoff control measures during the construction phase of land development projects is estimated at $2,000 per developed hectare or approximately $170 for an average residential lot. Capital costs for long-term runoff quality control measures following the construction phase are estimated at an additional $1,700 per hectare or $145 for an average residential lot.

An evaluation of runoff quality control initiatives within the City of Calgary will provide a

positive beginning to a program of basin-wide management practices for conditions throughout the Bow River Basin.

5.4.2 Existing Urban Development and the Need for Runoff Quality Control

The Task Force recommends creation of a program to monitor and evaluate the effect of runoff from existing urban development on Bow River water quality. From this program, objectives should be developed for runoff quality, and drainage basins should be selected on a priority basis for retrofitting with treatment facilities.

Using metropolitan Calgary as the focal point, a carefully designed program should be established immediately to assess available data and empirical evidence and collect additional information (see Recommendation 5.3.4, Urban Runoff) as appropriate to determine the composition of urban runoff considering:

- first flush storm runoff
- secondary storm runoff
- non-storm runoff

Objectives must be established to improve runoff quality at the point of discharge into the Bow and Elbow Rivers as well as other water courses such as Fish Creek and Nose Creek. These objectives should be reach-specific within a water course, be based on good environmental management and ensure that water quality objectives for the various surface waters in the Bow River Basin are upheld. The need for a retrofit program should then be assessed for urban storm drains that were designed solely to manage runoff quantity but fail to meet runoff quality objectives.

In developed areas the costs of retrofit programs such as detention ponds, wetlands and infiltration systems will be significant. The Calgary urban area totals 32,000 hectares of which 12,800 hectares (40%) currently receives some level of runoff treatment before entering the Bow River. This includes 1,083 hectares that drain into Glenmore Reservoir, which not only supplies drinking water but also acts as a sedimentation basin. Preliminary studies indicate that an additional 10,500 hectares (33%) can be retrofitted with wet sedimentation basins which typically remove between 50% and 80% of most pollutants found in runoff waters. This program would cost an estimated $1,050 per hectare for a total of $11,000,000. In some site specific instances supplemental technology beyond sedimentation may have to be considered.

For the remaining 8,700 hectares (27%) of the urban area, it is currently considered unrealistic to implement measures such as sedimentation ponds because these areas typically contain high density developments, such as the downtown core, where land for treatment facilities is not available. For these areas, investigations should be carried out for a program to control the quality of runoff at its source. Potential remedial measures include more frequent street cleaning, cleaning of catch basins, increased storm drain inspections and increased public awareness of urban runoff pollution.

5.4.3 Increasing Public Awareness about Urban Runoff

The Task Force recommends creation of a public education program on the contaminants discharged to the Bow River from storm sewers. The public must be made aware that it is part of the problem and that it can become part of the solution.

The public is not always aware of the effect that storm sewer drainage has on water quality in the Bow River Basin. Education projects such as Storm Drain Marking Program, run by Trout Unlimited Canada, should be encouraged and supported. This program involves working with community groups and schools to heighten awareness and to provide education on runoff issues by marking storm drains with fish symbols throughout communities in Calgary. Similarly, all property owners and tenants should be educated and encouraged to be diligent in preventing contaminants such as pesticides, fertilizers and wastes from entering storm drains adjacent to private and public property. Existing programs for the safe disposal of toxic materials, such as the Toxic Waste Roundup and Oil Drop should be encouraged and expanded.

5.5 RURAL RUNOFF

Runoff from intensive livestock operations that are poorly sited, designed or managed can adversely affect both surface and ground waters. Measures must be taken to control all new intensive livestock operations and to implement remedial measures on existing operations that have potential for adversely affecting surface waters in the Bow River Basin.

The application of agricultural chemicals (fertilizers, pesticides) for crop production has resulted in wide-spread surface and ground water contamination in North America. However, in the Bow River Basin, application rates of agricultural chemicals are relatively low and our climate and soil conditions are such that agricultural runoff is not believed to be as much a concern as in other parts of North America. Additional data are required to adequately address this issue.

5.5.1 New Intensive Livestock Operations

The Task Force recommends that the provincial government direct counties and municipal districts in the Bow River Basin to establish development control bylaws that require new intensive livestock developments as well as modifications or additions to existing facilities to conform with standards for siting, design and waste management practices. The Bow River Water Quality Council could closely monitor progress on this recommendation.

Alberta Environment and Alberta Agriculture, with input from other departments and producers, have prepared a Code of Practice (Confinement of Livestock Facilities Waste Management Code of Practice) for siting, design and management of intensive livestock operations. The Code of Practice is a voluntary guideline for producers and regulatory agencies to minimize the environmental and social impacts of such facilities, and to promote sanitation, health protection, and the use of animal

wastes as a resource. The Task Force believes it is time for the provincial government to direct the municipalities to translate the Code of Practice into enforceable bylaws and regulations.

As an example, the Municipal District of Kneehill has incorporated many aspects of this Code of Practice into a development control bylaw for new intensive livestock operations and modifications to existing operations (Municipal District of Kneehill No. 48, Land Use Bylaw No. 1061, May 1991). The bylaw provides for inspection and approval of projects by Alberta Environment, Alberta Health and Alberta Agriculture.

Technical assistance for the design of intensive livestock operations is available to producers from Alberta Agriculture.

Adaptations of the standards in the Code of Practice as development control bylaws, in the manner of Kneehill, would ensure that new intensive livestock operations would not contribute to surface and ground water contamination in the Bow River Basin.

5.5.2 Existing Intensive Livestock Operations

The Task Force recommends a program be established to identify existing intensive livestock operations that have the potential to adversely affect surface waters in the Bow River Basin. The program should include ranking problems as to severity, and the provision of technical advice and financial incentives for producers to implement remedial measures.

Alberta Environment and Alberta Agriculture should immediately prepare a systematic inventory and assessment of all intensive livestock operations within the Basin. The inventory should include the number and types of livestock, proximity to water courses, local drainage patterns, manure containment and handling facilities, and any other information relevant to an assessment of actual or potential impacts on the Bow River, its tributaries or irrigation canals. For example, the effect of feedlot runoff into Jumping Pound Creek and Big Hill Creek is of special concern to the Town of Cochrane. An inventory of problem sites in the Basin would cost about $75,000.

A provincial program is needed to provide technical assistance and financial incentives for producers to manage runoff and livestock waste in an environmentally sound manner. This may involve relocation of the site. Annual objectives to improve a number of operations in each municipality should be established to ensure all problems are under control within five years. An incentive program with provincial funds of $200,000 per year is reasonable.

As existing operations are updated a gradual overall decrease in contaminants from these facilities will occur. However, unless an incentive program is put in place, it may be several decades before a large reduction in existing runoff contamination will be seen.

Rural municipalities, working with the Bow River Water Quality Council, could administer the program. A source of funding to the municipalities could be from the existing Alberta Water

Management and Erosion Control cost sharing program, which is administered by Alberta Environment.

5.5.3 Open-Range Livestock Operations

The Task Force recommends a program be established to identify and assess the effects of open range livestock operations that front on water courses. For identified problem sites, remedial action should be taken through provisions of technical support and financial incentives to producers.

In addition to intensive livestock operations, all animals with regular direct access to streams, canals and other surface waters can adversely affect water quality through direct input of wastes. These open-range livestock can also accelerate erosion by trampling streambanks and interfering with streamside vegetation growth. This riparian vegetation is important to fish habitat and for erosion control, especially during floods. Identification of problem sites should cost about $50,000.

A remedial action plan for problem sites should be developed and implemented with incentive financing. The cost of the program cannot be determined at this time.

5.5.4 Agricultural Chemicals

The Task Force recommends that investigations be carried out to assess the impact of the use of agricultural chemicals (fertilizers, pesticides) on surface and ground water quality in the Bow River Basin to determine the need for and the nature of an agricultural runoff control program.

United States Environmental Protection Agency (EPA) studies show that agricultural chemicals are the greatest uncontrolled threat to surface and ground water quality in the U.S.A. Since 1980, the EPA and the Department of Agriculture have administered a Rural Clean Water Program that has resulted in a number of successful initiatives.

The program involves producers and state and local governments and the overall intention is to limit the impact of non-point source agricultural runoff, while at the same time sustaining or improving producer profits by improving the efficiency and conservation practices of farming and ranching. Initiatives under this program include:

- conservation tillage to reduce erosion and allow runoff to penetrate deeper and faster,
- terracing and other water control structures to reduce sediment loss during runoff,
- technical assistance such as computerized nutrient budgeting, education, demonstrations projects, media coverage and personal contacts to encourage voluntary programs aimed at the benefits of soil conservation and clean water

Limited comparative data indicates that the impact of agricultural chemicals on ground and surface waters in the Bow River Basin is not as serious as it is in other regions of Canada and the United States. An environmental report released by the Paris-based Organization for Economic Co-operation and Development confirms that Canadian farmers use chemical fertilizers and pesticides sparingly (see Appendix VI – Section 3.3).

Reasons cited include crop types, climate, soil types and relatively low application rates by producers. More detailed monitoring and assessments are needed to confirm this hypothesis (Recommendation 5.3.4). Studies should be conducted on both ground and surface waters, including irrigation return flows and effluent from subsurface drainage of salinized lands. Contaminants of concern are pesticides, nutrients, bacteria and salts.

If investigations indicate that problems are present or emerging from chemical pollution of ground and surface waters, then a program of management practices specifically directed to dealing with the problems will be necessary. Such a program would be compatible and may be administered in conjunction with the ongoing National Soil Conservation Program, which is being implemented across Canada.

5.6 GOLF COURSES

The Task Force recommends that rural and urban municipalities develop and implement a comprehensive set of land development regulations designed to limit the runoff of fertilizers and pesticides and provide overall water quality protection in the vicinity of golf courses.

As golf increases in popularity and golf course construction, expansion and renovation increases throughout the Bow River Basin, concerns regarding the environmental effects of golf courses are a source of considerable debate. With respect to water quality, these concerns centre on sedimentation of water courses, stormwater and irrigation runoff, groundwater contamination, thermal pollution of cold water fish habitat, and the effects of chemicals used in golf course operations.

Preliminary results of monitoring studies by Alberta Environment at selected golf courses indicate that the impact of existing golf courses in the Bow River Basin is limited. However, to maintain or even improve the existing situation good environmental management should be practised at current and future golf courses, and land development regulations for golf courses should be established. These should include methods to:

- integrate site designs with existing environmental conditions to limit the extent of forest clearing, land development and water demands
- create and maintain vegetation buffers adjacent to streams, wetlands and other golf course waterbodies
- collect runoff from sensitive areas and pass it through grassed swales, shallow marshes, vegetated filter strips, or forest buffers
- treat the first 1.5 cm of rainfall onto impervious areas with retention and sedimentation
- encourage self-contained irrigation systems and waste water irrigation so water withdrawals from natural streams are minimized
- limit water withdrawals so they do not infringe on Instream Flow Need (IFN) specifications, especially on small streams such as Fish Creek
- develop a pest management plan that encourages use of disease resistant grass species for fairways, tees and greens, use of biological

pest controls, selection of chemicals that are less toxic, less mobile and have a lower environmental persistence than those currently licensed for use

- restrict development in areas where the risk of ground or surface water contamination is significant
- develop an operating plan to strictly limit the use of pesticides and fertilizers and ensure they are applied under the supervision of licensed applicators
- implement surface and ground water monitoring programs

These regulations should be created and enforced by all municipalities. It is imperative these regulations be developed immediately so they can be applied to golf courses currently in the approval or development phases.

A retro-fit program of good environmental management for existing golf courses should also be implemented to ensure these facilities meet the conditions of the new regulations in a timely manner. The costs of this program should be borne by the golf industry.

5.7 CONTAMINATED GROUNDWATER SITES

The identification of severely contaminated groundwater inflow to the Bow River from the abandoned Canada Creosote site in downtown Calgary has heightened public awareness of this important water quality issue. The situation must be closely monitored and the site must be properly cleaned up or contained. Other potential sites should be investigated.

5.7.1 Canada Creosote Site in Downtown Calgary

The Task Force recommends that the Canada Creosote site on the bank of the Bow River be cleaned up or contained in a manner that will eliminate any significant risk to human health and the aquatic ecosystem. The Bow River Water Quality Council should represent the Bow River water users in the 1992 risk assessment and have input to the final decision on remediation.

Canada Creosote is a former wood preserving plant site in Calgary where railway ties were treated with creosote and pentachlorophenol (PCP). It was operational on the banks of the Bow River west of downtown from the mid 1920s until 1962. The site is underlain by an elongated pool (20,000 m^2) of wood preserving chemicals lying on the

Gravel washing pilot project at the Canada Creosote site in Calgary.

bedrock extending under the river. Wood preservative is a complex substance including polycyclic aromatic hydrocarbons (PAHs such as benzo-a-pyrene) and PCP. At certain times of the year, contaminated groundwater and occasional blobs of creosote seep into the Bow River. Since 1989, this seepage has been largely contained within a special berm enclosure built in the river adjacent to the site.

A 1989 review of the contaminant transport mechanisms and exposure of humans and aquatic organisms indicated:

1 Fish and wildlife are not considered at risk, other than in the immediate vicinity of the site.

2 No significant health risk exists to humans drinking water or eating fish from the river.

Alberta Environment is actively investigating remedial measures for the site that may include containment of the chemicals beneath the property, recovery pumping and treatment of the creosote, washing and recovery of material from the river bottom and other potential techniques. The department is also planning to conduct another health risk assessment in 1992 that will identify the hazards associated with major floods in the Bow River as well as hazards that may result from implementation of alternative clean-up measures. The Bow River Water Quality Council should be involved formally with the 1992 risk assessment evaluation procedure.

Clean-up or containment of creosote will be expensive. Action must ensure that the long term water quality integrity of the Bow River is maintained. If containment, rather than clean-up by removal of the creosote, is a more cost-effective remedial measure, then the Task Force believes this alternative should be considered as long as no risk to downstream water users exists. The Bow River Water Quality Council should have input to any decisions related to remediation of the site. We also recommend that the communities and residents in the vicinity, plus those downstream users potentially affected by the contaminated groundwater, be kept informed and consulted on a regular basis regarding progress on this situation.

5.7.2 Other Contaminated Groundwater Sites

The Task Force is concerned about the potential groundwater contamination of the Bow River from other contaminated industrial sites, especially in the Calgary area and recommends that a study be commissioned to further identify these sites, assess their potential to contaminate the river and recommend necessary action.

In the past, industrial practices did not always recognize the importance of preventing or controlling spillage of dangerous chemicals that could enter groundwater channels. The Bow River Basin contains significant sand and gravel deposits in its floodplain, which are hydraulically connected to the Bow River. Materials spilled to these aquifers can eventually reach the Bow River, as occurred in the case of the Canada Creosote site. The Help End Landfill Pollution (HELP) program has identified 92 abandoned landfills within the Bow River Basin. These and other potential contaminated sites that have been brought to the attention of the Task

Force are listed in Appendix VI. Other sites may remain unidentified.

The Task Force recommends that Alberta Environment commission a study to:

- conduct a comprehensive inventory of industries, landfills or contamination events (spills) in the Basin that may affect groundwater and Bow River water quality. This study should build upon and update the HELP program conducted in 1988
- estimate potential contaminant loading rates to the river from these sites so that those potentially affecting river water quality can be identified
- recommend further action to formally investigate or clean up any significant sites using a cautious, systematic approach. First priority must be give to the sites that are putting downstream water users or the aquatic ecosystem at risk.

This study should be completed within the next year and the findings reported to the Bow River Water Quality Council. Downstream water users and other stakeholders potentially affected by these sites must be kept fully informed of the findings and any follow-up action that is undertaken. The study will cost about $75,000.

5.8 OTHER IMPROVEMENT AND PROTECTION MEASURES

This section documents Task Force Recommendations that cannot be categorized into sections 5.1 through 5.7.

5.8.1 Inter-Governmental Coordinating Committee

The Task Force recommends a coordinating committee of government agencies be established to ensure inter-governmental management activities pertaining to water quality in the Bow River Basin are coordinated in an efficient manner. Alberta Environment should take responsibility for forming this committee.

Responsibilities for water quality monitoring, protection and enforcement are shared among several federal and provincial government departments and the municipalities in the Bow River Basin (Table 1). No one agency has overall responsibility for water quality protection for the entire river system, and the activities of these various agencies are often poorly coordinated.

The Task Force recommends a coordinating committee of government agencies involved in water quality management be established. A coordinating committee would improve the efficiency of program delivery, prevent duplication, and result in more consistent and timely responses to problems of interjurisdictional significance on a more cost-effective basis. Alberta Environment should take the lead in establishing this committee.

5.8.2 Environmental Protection and Enhancement Act

The Task Force supports the provincial initiative to develop and implement regulations for the new Environmental Protection and Enhancement Act and recommends that the Bow River Water Quality

Council provide input to the development of regulations for the new Act.

The Task Force believes the legislation is sound, and the Minister of Environment and his department should be complimented for assembling the various acts under the all-encompassing umbrella of environmental protection. The regulations developed for the new Environmental Protection and Enhancement Act have substantial implications for water quality management in the Bow River Basin. Consequently, the Bow River Water Quality Council should be actively involved in the development of these regulations.

5.8.3 River Basin Planning

The Task Force recommends that Alberta Environment give a high priority to initiating a Bow River Basin water management planning program to implement several of the recommendations of the Task Force. The Bow River Water Quality Council should participate in an advisory capacity.

A comprehensive water management planning program is required for the Bow River Basin. It is essential the river basin as a whole be included in the planning program and that water quality and water quantity issues be considered together. The planning program should include the development of reach-specific water quality objectives, determination of the assimilative capacity of river reaches, establishment of instream flow requirements to protect water quality and instream uses, flow regulation alternatives, and guidelines for water allocations. The Bow River Water Quality Council should participate in an advisory role, and public participation must be an integral component of the planning program.

5.8.4 Water Diversions from the Highwood River Sub-Basin

The Task Force recommends that any diversions of water from the Highwood River to the Little Bow River Basin not adversely affect downstream water quality and quantity in the lower Highwood and Bow Rivers.

The Task Force recognizes that the existing water diversion scheme to the Little Bow River Basin is under review, that instream flow requirements are being developed, and an environmental impact assessment (EIA) is proceeding. We strongly recommend these assessments consider the implications for the Bow River as a whole, recognizing the close relationship between water quantity and quality. The Bow River Water Quality Council should act in a review capacity during this EIA process to ensure water quality and quantity in the Bow River are not jeopardized.

5.8.5 Drinking Water Advisory

Good public health practices dictate all surface waters withdrawn for drinking from anywhere in the Bow River Basin must be disinfected, and the Task Force recommends that a public awareness program be conducted related to this issue.

All surface waters are subject to bacterial, viral or parasitic contamination. Discharge of sewage and agricultural runoff is not the only source of pathogenic organisms; river waters, even in the

mountain parks, can be contaminated with bacteria and parasites from many animals. Public health practice dictates that whenever water from the Bow River, or its associated irrigation districts, is used for domestic supply it must first be disinfected. Public awareness of this issue must be increased.

5.8.6 Heritage River Classification

If the Province of Alberta agrees to participate in the National Heritage River Program, the Task Force believes that the Bow River should be recommended for inclusion.

A provincial task force is currently investigating whether Alberta should officially take part in the National Heritage Rivers program. Via a special Heritage River designation, this program recognizes the unique natural characteristics, and social or historic value of selected rivers in Canada. The Task Force feels that the Bow River clearly qualifies for this program, and should be put forward as one of the candidate rivers from Alberta. Such a designation would further emphasize to the public the need for ongoing protection of this valuable provincial resource.

5.8.7 Spill Containment and Emergency Response

The Task Force recommends that spill containment and emergency response procedures be clarified and, if necessary, improved in areas of the Bow River Basin under federal government control. Coordination with provincial emergency response procedures is essential.

Accidental contaminant spills to the Bow River have the potential to severely affect downstream water users. The Bow River in the mountainous region is particularly vulnerable with the Trans Canada Highway and the railway paralleling the river. The City of Calgary has an ongoing program to identify, contain and remove materials spilled to its urban drainage system. As well, Alberta Environment has a Pollution Emergency Response Team that reacts quickly to hazardous spills. This team assists local municipalities and Banff National Park with containment and clean-up of spills. Interjurisdictional arrangements should be clarified and made formal. No similar arrangements currently exist within the Indian Reserves in the Basin. This situation should be rectified.

5.8.8 Statutory and Regulatory Efficiency

The Task Force recommends that legislation and regulations for water quality protection in the Bow River Basin be reviewed and clarified.

Water quality protection measures are distributed across a spectrum of jurisdictions and agencies within jurisdictions. Examples in the Bow River Basin include:

- Alberta Environment (Environmental Protection and Enhancement Act)
- Public Health Districts (Public Health Act)
- Alberta Labour (Plumbing and Drainage Act)
- Local Municipalities (Bylaws and Zoning Regulations)
- Federal Department of Indian and Northern Affairs (Indian Act)

- Federal Department of Environment
- Canadian Parks Service (Banff National Park)

Legislation and regulations can be complex, confusing and enforced in varying degrees. The Task Force feels strongly that this multiplicity must be clarified and streamlined so that all concerned with water quality issues can work with clearly defined expectations in terms of responsibilities and enforcement procedures.

5.8.9 Private Sewage Disposal

Contamination of surface waters can be a problem with poorly designed or installed private sewage disposal systems. The Task Force recommends that the regulation of private sewage disposal in provincial jurisdictions be consolidated within the mandates of Alberta Environment and Alberta Health, and the responsibilities of these two departments should be clearly delineated.

The regulation of private sewage disposal within Alberta is fragmented and inadequate. Many government departments are responsible for legislation governing different aspects of private sewage disposal. Alberta Labour is responsible for issuing permits and monitoring the development of individual private sewage disposal systems, and in the past has communicated its interest in transferring this responsibility to Alberta Health or Alberta Environment. Alberta Environment presently participates in the design, development and operation of communal sewage disposal. Alberta Health presently investigates complaints and referrals regarding private sewage disposal, and where appropriate, enforces the Public Health Act, Nuisance and General Sanitation Regulations.

Alberta Health has been receptive to a transfer of Alberta Labour mandate in this area provided that adequate resources are also transferred. The Task Force supports this initiative and believes it will be easier to maintain communication and achieve effective and timely control over private sewage disposal if fewer government agencies are involved.

5.8.10 Littering

The Task Force recommends that littering in the Bow River be reduced by improved public education and expanded river bank clean-up programs.

Littering in and along the banks of the Bow River is an ongoing problem that affects the enjoyment of recreational water users. Sources of littering are not limited to garbage from illegal dumping but also include trash left by thoughtless recreational users and the general public. Debris left on the banks and in the river is not only visually insulting but often poses a health threat to wildlife. Public education must be enhanced to increase the public's awareness of this problem and to make people understand they should be accountable for their actions. We support the existing clean-up programs in place, such as the annual spring clean-up within Calgary, and similar local programs should be considered for other reaches of the river. With its broad spectrum of stakeholder representation, the Bow River Water Quality Council could initiate and co-ordinate an annual basin-wide clean-up program.

6.0 Cost of Recommendations and Funding Opportunities

The Bow River Water Quality Task Force is conscious that the costs of implementing its recommendations cannot all be absorbed within existing resource allocations and programs. In this section of the report we overview the current expenditures for water quality management in the Basin, discuss the added costs associated with our recommendations and identify opportunities for obtaining additional funds.

6.1 Existing Expenditures

Alberta Environment is the major agency responsible for water quality management of the Bow River, and their total water quality related expenditures in the Basin for the fiscal year 1991-92 is approximately $1,215,000 for staff and contractual services. This includes $113,000 for river water quality monitoring, $425,000 for Basin planning activities and $230,000 for impact assessments. Enforcement costs approximately $340,000 and development of permits and licenses $110,000. In addition to these "normal" expenditure levels, Alberta Environment is spending an additional $1,600,000 on the Canada Creosote site in 1991-92. It is anticipated the federal government will provide matching funds for Canada Creosote of approximately $1,500,000.

With respect to capital expenditures for municipal water supply and sewage treatment, provincial grants from Alberta Transportation and Utilities have averaged approximately $6,500,000 per annum since 1979. These grants are only made available to municipalities with populations of less than 45,000. In the past, these municipalities have paid on average 55% of total project costs. The municipal project share has increased in recent years.

Other agencies, as listed in Table 1, also incur considerable expenditures. For instance, Canada Parks Service expenditure for 1991-92 will be about $40,000 for monitoring, setting standards and environmental assessments. Environment Canada will spend about $40,000 on monitoring in 1991-92.

6.2 Cost of Task Force Recommendations

A summary of the costs associated with the recommendations of this Task Force are presented in Table 2. These are approximate expenditure increases for water quality management and planning above existing levels. This table does not account for capital cost increases covered under the Municipal Water and Sewage Treatment Grant Program, for example, the Canmore Regional Sewage Treatment Plant. It also assumes existing programs and initiatives will continue to be funded at current levels. Ongoing expenditure increases are primarily for increased river monitoring, the Bow River Water Quality Council and the annual State-of-the-River report. Other recommendations will require new resources to be allocated on a one-time basis. However, it is probable many of these funds will be spent gradually over a three to five year period.

The cost of implementing disinfection at the Fish Creek Sewage Treatment Plant (STP) has been

Table 2
Approximate Cost Summary For Recommendations of the Bow River Water Quality Task Force
(These are in addition to existing expenditures and programs)

			NEW PROGRAMS	
	RECOMMENDATIONS		ONE-TIME	ANNUAL
5.1.1	Water Quality Council			$200,000
5.2.1	Sewage Treatment	Long-Term Planning Studies	$ 100,000	
5.2.5		Disinfection at Fish Creek Plant	$2,200,000	
5.3.1	Monitoring	Initial Design and On-Going Costs	$ 50,000	$125,000
5.3.2		State-of-River Report		$ 50,000
5.3.4		Urban Runoff Study*	$ 600,000	
5.5.2	Rural Runoff	Intensive Livestock Impact Study and Remediation Program*	$1,075,000	
5.5.3		Open-Range Impact Study	$ 50,000	
5.7.2	Contaminated Sites	Completion of Site Inventory	$ 75,000	
TOTALS			$4,150,000	$375,000

* *Spread over next three to five years.*

included in Table 2, since disinfection at Fish Creek STP (unlike Bonnybrook STP) is not being considered in the near-term. Costs for the Fish Creek disinfection and the $140,000,000 expansion and improvement expenditure for Bonnybrook, which is being undertaken by the City of Calgary, are not covered under existing Provincial cost-sharing programs.

6.3 Funding Opportunities

In addressing the issue of funding water quality protection for the Bow River and the specific recommendations presented in this report, the Task Force considered the general philosophy of funding and developed some overall principles. It then considered various alternative methods to raise such funds.

Overall Principles

a To implement the recommendations of this Task Force, additional resources will have to be allocated for water quality protection and management within the Bow River Basin. However, government resources are strained and the potential for receiving substantial additional funds from the Provincial Treasury is limited. Before allocating new resources for water quality management current funding programs must be reviewed to ensure that they are being spent efficiently, and duplication of services should be eliminated. The Task Force strongly believes that the population of the Bow River Basin justifies greater allocation of existing Provincial resources for water quality management than has been the case in recent years.

b The Province of Alberta should consider expanding the philosophy of using dedicated funds to finance specific initiatives rather than using general revenues supported by the overall provincial tax base. While this approach is not commonly used by the Province at this time, the Task Force feels the general public will look more favourably upon contributing resources to a specific program if they know and understand how these resources are used.

c The Province of Alberta has adopted a "polluter pay concept" with respect to pollution control. This generally means that the costs of either municipal or industrial effluent treatment is borne by the parties responsible. The Task Force is fully in support of this concept and feels it should be continued. To date the application of the polluter pay concept has not included charging polluters for the actual disposal of treated wastewaters to rivers like the Bow. This would be analogous to charging rent for use of the river's assimilative capacity. The Task Force feels such a charge, in the form of water disposal fees, should now be considered.

d Water is a precious commodity that we all too often take for granted. The Province should recognize the value of water and review the need for a user fee system. Charging for water, as well as access to it, will not only promote its conservation, but also generate funds that can be used for management and protection. We recognize this is a complex and controversial issue with ramifications that extend beyond protecting Bow River water quality. For example, some stakeholders such as the irrigation communities see this as another form of taxation against their members and so oppose the implementation of any form of water user fees. In the following section the Task Force presents ideas on funding alternatives the Province should consider in developing this concept. However, no matter what approach is taken in developing any user fee system, it must be fair and equitable to all parties involved. It must also be sensitive to the varied uses of water, whether they are consumptive or non-consumptive, and also to the impact of such uses on the river.

e A high level of water quality protection for the Bow River will provide long term cost savings in the area of water treatment. Capital and operating costs are a direct function of the quality of the water being treated. Since the Bow River is such an important municipal water source, it is in our best

interest to keep it clean. We must also make the general public aware that they can directly protect and even improve water quality through their own actions.

f A high level of water quality protection should be built into the capitalization of new developments so as to limit the need for ongoing resource expenditures, or the requirement for expensive clean-up procedures in the long term. Pollution control at its source is preferable to discharging pollutants to the river and incurring higher downstream water treatment costs and costly remedial measures. However, many existing developments that are not in compliance with today's standards met previous environmental standards and guidelines or were constructed before applicable guidelines were in place. In these cases it is appropriate that corrective measures be cost-shared with the beneficiaries of these measures. Such beneficiaries may be municipal, provincial and/or federal taxpayers, in varying proportions, depending upon the nature of the problem and the beneficial impacts of the corrective measures.

g The Bow River is a shared resource. About forty percent of the river falls within Banff National Park and Indian reserves. Therefore, a federal role in its protection is imperative. The federal government must consider the significance of the Bow River to Canada's first National Park and for Canada's responsibilities on Indian reserves, management of interprovincial waters, and the significance of the river to the historical development of western Canada. Thus, the costs of water quality management should be shared between the provincial and federal governments.

h There should be an annual accounting and review of funds spent by all jurisdictions on water quality management in the State-of-the-Bow-River Report.

Funding Alternatives

The Task Force puts forth the following alternatives that the Provincial Government should consider in whole or in part when looking for funds to implement the recommendations made in this report. It is likely that a combination of several of these options may be preferable to any one alternative. Emphasis should be on measures that provide water users with flexibility, incentives to conserve water, minimize waste disposal to the river and control pollutants at their source.

a **Review and Optimize Existing Resources** The existing provincial priorities for monitoring should be reviewed and resources potentially re-allocated to meet the current information needs of government and the public. In doing this review, active stakeholder involvement in river monitoring should be solicited from industries, major municipalities and irrigation districts located along the Bow River.

With respect to implementation of other water quality improvement measures the applicability of existing grant or incentive programs should be evaluated. In some cases these programs should be redirected to expand their water

quality protection or remediation function. Examples include:

- Federal Green Plan
- Municipal Water Supply and Sewage Treatment Grant Program
- Alberta Water Management and Erosion Control Program
- National Soil Conservation Program
- Heritage Rivers Program

b Water User Fees At present, Alberta does not charge for the use of water as a commodity, with the exception of hydropower, which produces revenues of about $300,000 per year from hydropower plants in the Bow and North Saskatchewan River Basins. Development of an expanded system for water use charges is controversial, complex and will take time to develop. All water users should be involved in its development if it is to be a fair and equitable system. Such a system must recognize both consumptive and non-consumptive uses.

Consumptive water uses actually permanently remove water from the river system. On average, these users consume in total between 20% and 50% of the river's natural flow, depending upon annual moisture conditions in the Basin. Of the water consumed in the Bow River Basin irrigation accounts for 95%, municipal supplies consume 4% and industries use 1%. The value of water is not equal among users, and the impact on river water quality is not the same for each use. Therefore, differential water rates would have to be considered.

Non-consumptive water uses "borrow" the water but do not remove it permanently from the river system. Hydropower generation currently is assessed a non-consumptive water use fee that goes directly into general provincial revenues.

Anglers are perhaps the most identifiable non-consumptive water users, and they have a very vested interest in protecting the quality of the Bow River. They could be assessed a dedicated user fee for fishing in the Bow River much like the trophy fee charged for angling in some northern lakes. Trout Unlimited has indicated that their organization would be supportive of imposing a surcharge on fishing licenses for Bow River anglers, provided the revenues generated were dedicated to improving conditions in the Bow River. While it would be more difficult to charge other recreational users such as boaters, hikers and picnickers, some recreational groups might consider including a "Buck for the Bow" fee in their membership programs.

c Water Disposal Fees Water disposal includes industrial and municipal effluents, plus urban and agricultural drainage waters. A fee based on their disposal volumes, which is adjusted according to effluent quality, could be considered. There are only five direct industrial effluent dischargers in the Basin, and their total effluent volumes are relatively small. Municipal effluents, and especially those from Calgary, are the major direct source of wastewater disposed in the river.

Indirect industrial dischargers refer to those industries and commercial enterprises that discharge to municipal treatment systems. In Calgary they account for approximately 35% of the total wastewater and sewage generated. About 10% of these

indirect industrial dischargers are already levied a surcharge by the City of Calgary, based upon their effluent quality and quantity. They could also be assessed a user fee that reflects their indirect use of the river's assimilative capacity.

Urban runoff is a water disposal use that could also be subject to disposal fees, as could return-flow from irrigation districts and intensive livestock facilities. However, estimating effluent volumes and quality for these pollution sources is more difficult than estimating those of industrial or municipal effluents.

In developing water disposal fees a number of issues should be considered:

- costs already borne by the taxpayers through their general mill rate assessment or their utility bills
- should fees potentially be adjusted based upon the quality of the effluent or the level of treatment prior to discharge
- there should be economic incentives for zero discharge

d Water Quality Trust Fund A fund should be established that is dedicated to the improvement and ongoing protection of water quality within the Bow River Basin. Such a fund could be used to finance the Bow River Water Quality Council and for the implementation of other recommendations put forward by this Task Force. A portion of the water use and disposal fees collected in the Basin should be directed to this fund. There is precedent in the "Buck for Wildlife Programs", which collect revenues as a wildlife user fee added to hunting licenses.

Such a water quality trust fund might receive tax exempt donations from various groups or individuals interested in the Bow River and its protection.

e Tradeable Effluent Permits This concept would involve the province restricting the total number of effluent permits (municipal and industrial) to be issued for each reach of river. The limit would be well below the cumulative assimilative capacity of the river to receive wastewaters. The permits would be sold by the province, and thereafter they could be subject to re-sale among existing or potential dischargers.

This concept is relatively new and may have complex ramifications some of which may or may not be suitable for the Bow River Basin at this time.

f Tax on Fertilizers and Pesticides Urban and rural runoff of nutrients, and potentially pesticides, is a water quality protection issue throughout the Bow River Basin. Funds for control and management of runoff of these pollutants could be obtained by levying a special tax on those products that are not certified environmentally friendly.

g Increased Fines Fines for violation of water pollution control and fishing regulations could be substantially increased. The Environmental Protection and Enhancement Act allows for increased polluter fines, and the Task Force supports this initiative.

Appendix I

Members of Bow River Water Quality Task Force

MEMBER	ALTERNATE	AFFILIATION/REPRESENTING
Ms. Martha Andrews, Bow River Water Users Assoc.	Ms. Ruby Hiebert, Bow River Water Users Assoc.	Bow River Water Users Association
Mr. Jay Bartsch, Southern District Manager, Ducks Unlimited	Mr. Ed Houck, Southern Alberta Biologist, Ducks Unlimited	Wildlife Interest Groups – Ducks Unlimited Canada, Fish & Game Assoc.
Mr. Stewart Bexton, Cominco Calgary, Nitrogen Operations	Mr. Bill Carlson, Assistant Superintendent, Alberta Natural Gas	Industry – Point Discharge
Mr. Norm Carlson, Calgary Health Services		Health Units in Bow River Basin
Mr. Paul Daniels, Councillor, Town of Cochrane		Town of Cochrane
Mr. John W. Donahue, Q.C. Donahue Rondeau, Barristers & Solicitors		Chairman
Mr. Robert Filkohazy, District Chairman, Unifarm	Mr. Ben Armstrong Unifarm	Industry – Agriculture
Her Worship Jean Franklin, Mayor, Town of Brooks		Downstream of Calgary Urban Municipalities – Brooks, Bassano, Redcliff, Medicine Hat
Mr. David Harvie, Urban Development Institute		Industry – Land Development
Mr. Gordon Hilton, Director, Western Irrigation District	Mr. Vern Hoff, Chairman of Board, Western Irrigation District	Downstream of Calgary Western Irrigation District area – County of Wheatland #16, Strathmore, Gleichen, Other Users
Mr. Fin McPherson, General Manager, Bow River Irrigation District	Mr. Brian Hagen, Executive Assistant, Bow River Irrigation District	Bow River Irrigation District
Mr. Bill Mortensen, Chairman, Eastern Irrigation District	Mr. Jim Webber, General Manager, Eastern Irrigation District	Eastern Irrigation District

MEMBER	ALTERNATE	AFFILIATION/REPRESENTING
Mrs. Elaine Peake, Mayor, Summer Village of Chestermere Lake		Downstream of Calgary WID area – Summer Village of Chestermere Lake Recreational Interests
Mr. Hugh Quintilio, City Engineer, City of Calgary	Wally Meckelborg, Manager of Sewage Division, City of Calgary	City of Calgary
Mr. Bob Reynolds, Councillor, Town of Canmore	Mr. Gary Sargent, Associate Superintendent, Banff National Park	Upstream of Calgary – MD of Bighorn #8, Banff National Park, Kananaskis Country, Lake Louise, Banff, Canmore
Mr. Jim Rouse, Director, Bow River Chapter, Trout Unlimited Canada	Mr. Don Pike, General Manager, Trout Unlimited Canada	Fishery Interest Groups – Trout Unlimited, Fish & Game Assoc., Calgary Hook & Hackle Club, Bow River Outfitters Assoc. Westwind Flyfishers
Norman Running Rabbit, Natural Resources Director, Siksika Nation, Tribal Administration	Mr. Darren Many Heads, Natural Resources Officer, Siksika Nation, Tribal Administration	Indian Bands
Mr. Al Taylor, Bow Waters Canoe Club	Ms. Kathleen Staniland, Calgary Area Outdoor Council	Recreational Interest Groups – Calgary Area Outdoor Council and its Member Organizations
Mr. Gord Vincent, Councillor, Municipal District of Rocky View #44	Flores Groeneveld, Councillor, Municipal District #31	Adjacent to Calgary – MD of Rocky View #44, MD of Foothills #31
Mr. Dick Way, Manager, Generation Scheduling, TransAlta Utilities	Mr. L.E. Nelson, Supervisor, Water Management Power Planning, TransAlta Utilities	Industy – TransAlta Utilities
Mr. Wally Wells, Councillor, County of Newell No. 4		Downstream of Calgary Rural Municipalities– County of Newell #4, County of Vulcan #2, MD of Taber

Background

The Bow River in southern Alberta is a very important provincial resource. It is used extensively for recreational activities such as boating, fishing, swimming, and a variety of land based activities. The river has an international reputation for a large and plentiful rainbow and brown trout fishery. It attracts fishermen from all over the world.

The Bow River also serves southern Alberta as a source of water for domestic, municipal, industrial, hydroelectric energy production, and irrigation purposes. Water demands for these uses are increasing.

As the population within the basin and demands on the Bow River increase, inadequate water supply and poor quality water pose a threat to water users. If the river is to continue to serve a diversity of uses, more intensive management of the quality, supply and use of the water will be required.

Lunch break on the banks of the Bow.

Following a December 1989 meeting in Brooks with the Bow River Water Users Association, as well as meetings with other interest groups, the Honourable Ralph Klein, Minister of the Environment committed to establishing a task force to address water quality problems along the Bow River. Terms of Reference for the task force were drafted.

An organizational meeting was held on May 14, 1990 to review the draft terms of reference and to initiate selection of task force members. In his introductory remarks, at the May 14th meeting, Mr. Klein noted that the Bow River Water Quality Task Force is a pilot project that could be repeated for other streams in Alberta.

The following revised terms of reference are based upon the initial draft and comments received from representatives of stakeholders and special interest groups.

Task Force Membership

The Task Force should have broad representation from stakeholders and interest groups, but should not be so large as to be unworkable. Task Force members should be selected to represent groups of municipalities, stakeholders and special interest organizations. Subcommittees may be necessary to facilitate continuous interaction with all affected parties.

Task Force membership should be limited to 15 to 20 individuals.

Objectives

The objectives of the Bow River Water Quality Task Force are to:

1. Enquire into the specific causes of pollution in the Bow River.
2. Recommend specific measures to reduce or eliminate those causes of pollution. If there is insufficient information available to recommend specific measures, recommend a course of action to further address issues or concerns.
3. Recommend measures that would protect the Bow River against sources of pollution in the future.
4. Provide preliminary cost estimates and identify the benefits of implementing various recommendations.

5 Identify funding alternatives for implementation.

Scope

There have been numerous investigations related to Bow River water quality and pollution control conducted within government and by external agencies. The Task Force will consider all existing information and data to address Bow River water quality issues. Where there is sufficient available information to adequately address issues, specific measures to resolve the issues will be recommended. For issues where inadequate information is available, courses of action to further address the issues will be recommended.

The Task Force will focus on water quality in the Bow River; however, sources of pollution in the entire basin that either individually or collectively could have a significant impact on Bow River water quality will be considered. Since water quality and water quantity are interdependent, the Task Force will consider the effects of flow regulation and water diversions and withdrawals on water quality.

Broad public input through Task Force hearings or public meetings throughout the basin are considered to be beyond the scope of the Task Force assignment. Public input on the Task Force report subsequent to the completion of the assignment will be the prerogative of the Minister of Environment.

Schedule

It is envisioned that the Task Force will complete its work within one year. A report and recommendations will be submitted to the Minister by June 30, 1991.

Reporting

The Task Force will report directly to the Minister of Environment.

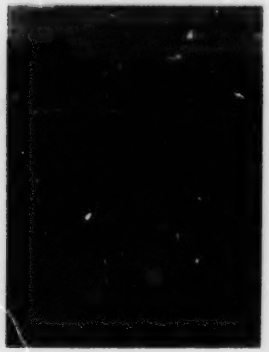
Resources

The Task Force will focus on available information in conducting its work. The Task Force will have access to all available information within Alberta Environment and other government departments. An official from Alberta Environment will be assigned to co-ordinate government input. Relevant information will also be solicited from non-government agencies. Up to $100,000 will be made available to offset administrative costs and consultant costs (if a consultant is necessary).

The above Terms of Reference are approved as drafted.

original signed by Ralph Klein

Hon. Ralph Klein,
Minister of the Environment



Scenic upper reach of the Bow River.

The recommendations contained here are reach specific. The major recommendations are given in section 5.

Reach 1 – Bow River headwaters to upstream Lake Louise.

Pollution Problem	Pollution Sources	Recommendations
■ Water quality along this reach is excellent with little or no adverse human impacts. However, naturally occurring bacteria, parasites and viruses make untreated river water unsafe for human consumption.	■ *Giardia* and other parasites, bacteria and viruses are contributed naturally to the river by warm-blooded animals.	■ Public advisories as to the need for disinfection of all surface waters prior to drinking must be continued. ■ We must continue to recognize the pristine nature of this river reach and emphasize its preservation. It should be considered for inclusion in the National Heritage Rivers Program.

Reach 2 – Lake Louise to Banff Park Boundary.

Pollution Problem	Pollution Sources	Recommendations
■ Like Reach 1, naturally occurring bacteria, parasites and viruses make untreated river water unsafe for human consumption.	■ *Giardia* and other parasites, bacteria and viruses are naturally contributed to the river by warm-blooded animals.	■ Public advisories as to the need for disinfection of all surface waters prior to drinking must be continued.
■ Historically there have been high levels of coliform bacteria.	■ Overloading of the Banff sewage treatment plant has been a problem in the past, but a new plant started-up in 1989 has effluent disinfection, as does Lake Louise. The effect of urban runoff on coliforms is not known.	■ The potential impact on the river of urban runoff from Banff and Lake Louise should be investigated.
■ Potential for enhanced weed and algal growth below Banff and Lake Louise sewage outfalls.	■ Neither Banff nor Lake Louise sewage treatment plants have phosphorus removal.	■ Studies should be initiated to investigate the need for phosphorus removal at Banff and Lake Louise sewage treatment plants.

Reach 3 – Banff Park to Bearspaw Dam (including Ghost Reservoir, Spray Lake and Kananaskis River)

Pollution Problem	Pollution Sources	Recommendations
■ Increasing levels of coliform bacteria.	■ Lack of disinfection at Canmore sewage treatment plant and sewage lift station flooding at Canmore due to high river water levels. Overall population growth in Canmore Corridor.	■ In the long term, a new state-of-the-art regional sewage treatment plant should be built to serve the entire Canmore Corridor. In the short term, the lift station flooding problem at Canmore should be solved and effluent disinfection considered. Because of its proximity to Calgary, the Town of Cochrane should pipe its wastewater to Calgary for treatment.
■ Concern about taste and odour in Cochrane's water supply.	■ There is no identified source and the problem could be due to naturally occurring organic compounds in runoff.	■ Investigate effect of feedlot runoff into Jumping Pound Creek and Big Hill Creek and its subsequent effect on Cochrane's water supply if necessary.
■ Potential impacts on Bow River water quality due to golf course development in Canmore Corridor.	■ No evidence exists at present that golf courses are affecting Bow River water quality.	■ Continue to monitor the impact of existing and future golf course development. Encourage implementation of design criteria that eliminate runoff of fertilizers and pesticides. Encourage use of environmentally friendly fertilizers and pesticides.

Reach 4 – Below Bearspaw Dam to WID Weir (including Elbow River, Nose Creek, Western Irrigation District and Chestermere Lake).

Pollution Problem	Pollution Sources	Recommendations
■ Presence of organic contaminants in Bow River downstream of Canada Creosote site.	■ Contaminated groundwater seeping into the Bow River.	■ Site must be remediated in a cost-effective way so there is no increased risk to downstream water users and the Bow River fishery.
■ Concentrations of certain trace metals non-compliant with guidelines for aquatic life.	■ While urban runoff may contribute to elevated levels of some metals, a substantial proportion is likely associated with natural weathering of rocks in contributing watersheds.	■ Establish reach-specific water quality objectives that account for natural conditions and clarify actual impact of urban runoff through monitoring. Treat urban runoff if necessary.
■ Elevated coliform bacteria and nutrients levels in Chestermere Lake, WID Canals and Glenmore Reservoir.	■ Most probable source is urban runoff. Intensive livestock operations may be a secondary source.	■ Urban runoff to WID Canal and Glenmore Reservoir is under study, and action to eliminate impacts should proceed. Other sources, such as intensive livestock operations along Nose Creek and WID system should be investigated.
■ Accumulation of silt deposits and heavy growth of aquatic plants in WID Canals and Chestermere Lake.	■ Most significant source is urban runoff to WID Canal, plus wind and water erosion from surrounding agricultural lands.	■ This Task Force endorses Summer Village of Chestermere Lakes proposal to clean up the lake through dredging.
■ Potential tainting of Bow River sport fish.	■ Could be contributed by natural processes, urban runoff and contaminated groundwater.	■ Issue requires clarification.
■ Debris in river and along banks.	■ Littering in Calgary urban area.	■ Control littering through better education.

Reach 5 – Below WID Weir to Highway 22X.

Pollution Problem	Pollution Sources	Recommendations
■ Coliform bacteria levels exceed published guidelines for contact recreation and irrigation.	■ Sources include Calgary's two sewage treatment plants and urban runoff.	■ Disinfection is to be implemented at the Bonnybrook Sewage Treatment Plant in 1994. Additional river monitoring should be undertaken to clarify need for treatment of urban runoff. Disinfection should be implemented at the Fish Creek Plant.
■ Excessive weed growth and elevated phosphorus levels.	■ Weed growth has declined since phosphorus control was implemented at Calgary STPs in 1983. However, phosphorus levels are still non-compliant with published guidelines. Excessive weed growth is enhanced by low river flows.	■ The ultimate assimilative capacity of the Bow River for disposal of urban runoff and sewage should be defined once reach-specific water quality objectives are established. This may identify the need for additional sewage treatment or increased river flows on an annual or seasonal basis.
■ Elevated ammonia nitrogen levels, which are potentially toxic to aquatic life.	■ Sewage discharges are the primary contributor.	■ The City of Calgary's proposal to incorporate nitrification (to convert ammonia to nitrate) into the Bonnybrook STP expansion should eliminate the problem.
■ Presence of organic contaminants.	■ Canada Creosote site and other potential contaminated groundwater sites along the Bow River.	■ Control creosote migration from Canada Creosote site. Identify and investigate other potential groundwater sources, such as the Ogden groundwater channel.

Reach 5 – Below WID Weir to Highway 22X (continued)

Pollution Problem	Pollution Sources	Recommendations
■ Floating garbage.	■ Littering.	■ Control littering through better public education.
■ Oily smell along river.	■ No identified source.	■ Investigate cause.
■ Potential for elevated salts levels during spring runoff.	■ Salts in urban runoff.	■ Clarify impact through monitoring.

Reach 6. Highway 22X to Carseland Weir (including Sheep and Highwood Rivers and Bow River Irrigation District)

Pollution Problem	Pollution Sources	Recommendations
■ Coliform bacteria levels occasionally non-compliant with published guidelines for contact recreation and irrigation.	■ Transport from Reach 5 is the major source.	■ Control bacterial loadings from the Calgary urban area.
■ Nighttime oxygen levels fall below 5.0 mg/L.	■ High aquatic weed and algal growth, (due to transport of nutrients from Reach 5) combined with low river flows.	■ Establish reach-specific water quality objectives for oxygen, then establish river flows and effluent loadings which allow objectives to be met.
■ Excessive weed growth and elevated phosphorus levels.	■ Phosphorus levels contributed by upstream sources have declined in recent years. However, levels are still non-compliant with published guidelines. Excessive weed growth is enhanced by low river flows.	■ A reach-specific phosphorus objective should be established and appropriate water management practices implemented to ensure it is met. ■ Investigate need to control nitrate emissions to river as a weed control factor.

Reach 6. Highway 22X to Carseland Weir (including Sheep and Highwood Rivers and Bow River Irrigation District) (continued)

Pollution Problem	Pollution Sources	Recommendations
■ Seasonally low river flows.	■ Minimum Bow River flow requirements and water diversions.	■ Minimum flows should be reviewed and, if necessary, adjusted. Impacts on Bow River water quality of all future water diversions anywhere in the Basin must be carefully evaluated. This includes the Highwood River diversion to the Little Bow River.
■ Concern about oily taste in fish.	■ No identified source in reach. Potential sources include sewage discharges, urban runoff and contaminated groundwater input to upstream reaches.	■ Issue requires further clarification.

Reach 7. Below Carseland Weir to Bassano Dam (including Eastern Irrigation District)

Pollution Problem	Pollution Sources	Recommendations
■ Coliform bacteria levels non-compliant with published guidelines for contact recreation and irrigation.	■ Upstream sources include Calgary sewage, urban runoff and agricultural runoff. Relative importance of each source is not known.	■ Situation should improve with disinfection at Bonnybrook STP. Monitoring program should be implemented to identify other significant sources that could be reduced or eliminated. In the case of Federal lands, this monitoring should be coordinated with Federal Agencies.
■ Aluminum, chromium, copper, iron, lead and manganese levels non-compliant with published guidelines.	■ High metal levels primarily derived from natural watershed erosion; other potential sources include urban runoff and treated sewage.	■ Reach-specific water quality objectives should be established and the significance of man-made sources clarified.
■ Concern about taste and odour in water supplies.	■ No identified source.	■ Organic content and algal growth in waters used for municipal supply should be controlled whenever possible.
■ Weed growth in river and irrigation canals.	■ Nutrients from upstream reaches, silt accumulation in canals, low river flows.	■ Establish reach-specific water quality objectives for nutrients, and manage river flows and nutrient sources so objectives can be achieved.
■ Brown foam on river.	■ No identified source.	■ Investigate further.

Reach 8. Below Bassano Dam to Oldman River.

Pollution Problem	Pollution Sources	Recommendations
■ Coliform bacteria levels non-compliant with published guidelines for contact recreation.	■ Transport from upstream reaches and intensive livestock operations.	■ Control sources both upstream and within the reach.
■ Weed and algal growth in river.	■ Transport of nutrients from upstream reaches and low river flows.	■ Establish reach-specific objectives and manage nutrient sources and river flows so objectives can be achieved.
■ Brown foam on river	■ No identified source.	■ Investigate further.

Appendix IV

List of Task Force Presentations

PRESENTATIONS/AFFILIATION	SUBJECT MATTER
Mr. Allan Hingston, HELP Project Manager, Alberta Environment	Help End Landfill Pollution Project, Canada Creosote Site,
Mr. Dave Trew, Mr. Al Sosiak, Dr. Anne-Marie Anderson, Environmental Quality Monitoring Branch, Alberta Environment	Bow River Water Quality Overview
Asoke Weerasinghe, Municipal Branch, Alberta Environment	Urban Stormwater Runoff, Municipal Sewage
Mr. Barry Kobryn, Laboratory Supervisor, City of Calgary	City of Calgary Urban Runoff
Mr. Wally Meckelborg, Mr. Mike Atkins (consultant), Mr. Gord Macdonald (consultant), City of Calgary	City of Calgary Sewage Treatment
Kim LaLonde, Corporate & Strategic Management Division, Alberta Environment	Proposed Environmental Legislation
Mr. Scot McClure, Mr. Wally Nahulak, Water Quality Branch, Alberta Environment	Industrial Effluent Control
Mr. Walter Ceroici, Groundwater Protection Branch, Alberta Environment	Contaminated Groundwater Sites
Mr. Dick Way, Manager, Generation Scheduling, TransAlta Utilities	Hydro Power Production
Mr. Jim Webber, General Manager, Eastern Irrigation District	Water use in the Eastern Irrigation District
Mr. John Rebus, Second Vice-President, Unifarm	Intensive Livestock Operations, Agricultural Chemicals

PRESENTATIONS/AFFILIATION	SUBJECT MATTER
Mr. Bryan Kemper, Mr. Dave Trew, Mr. Al Sosiak, Environmental Quality Monitoring Branch, Alberta Environment	Water Quality Monitoring
Mr. Wayne Inkpen, Pesticides Management Branch, Alberta Environment	Agricultural Chemicals, Golf Course Chemicals
Mr. Mike Bennett, Water Quality Branch, Alberta Environment	Intensive Livestock Operations
Mr. Brian West, Waste Management Specialist, Alberta Agriculture	Intensive Livestock Operations
Dene Berry, Investigations Branch, Alberta Environment	Emergency Response to Spills
Mr. Denis St. Arnaud, Mr. Keith Cathers, Plumbing and Gas Services, Alberta Labour	Private Sewage Disposal Systems
Dr. Brent Friesen, Mr. Norm Carlson, Calgary Health Services	Public Health Concerns
Mr. Al Borgardt, Hazardous Materials Section, City of Calgary	Calgary's Response to Hazardous Spills
Mr. Al Taylor, Calgary Area Outdoor Council	River and Valley Recreational Use
Ms. Elaine Peake, Mayor, Summer Village of Chestermere Lake	Water Quality & Recreational Lakes
Mr. Jim Rouse, Mr. Neil Jennings, Trout Unlimited	The Bow River Fishery
Mr. Dick Hart, Planning Division, Alberta Environment	Water Use, Legal Arrangements, Institutional Arrangements
Dr. Dixon Thompson, Faculty of Environmental Design, University of Calgary	Urban Growth & Water Quality Issues, Institutional Options, Funding Approaches

PRESENTATIONS/AFFILIATION	SUBJECT MATTER
Mr. Gary Sargent, Assistant Superintendent, Banff National Park	Banff Recreational Issues
Mr. Bob Reynolds, Councillor, Town of Canmore	Recreational Issues in Kananaskis Country and Canmore Corridor
Mr. Norman Running Rabbit, Tribal Councillor, Siksika Nation	Native Concerns
Mr. Al McPhail, President, WER Engineering	Highwood/Little Bow Project
Mr. Allan Strome, Director of Special Projects, Alberta Environment	Future Water Allocations for Irrigation
Mr. Gary Szabo, Trout Unlimited	Storm Drain Marking Program
Mr. John Barrett, Mr. Dennis Johnson, Bonnybrook Sewage Treatment Plant, City of Calgary	Bonnybrook Sewage Treatment
Mr. Colin Beresford, Acres International	Canada Creosote Remedial Action Plan
Mr. John Thompson, Senior Economist, Alberta Environment	Funding Options
Mr. Alan Pentney, Regional Engineer, Municipal Branch, Alberta Environment	Sewage Treatment along River

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